Technical Review

Evaluation of Alternatives for 327 Building Hot Cell Cleanout

April 2001

-Business Sensitive-

.

Evaluation of Alternatives for 327 Building Hot Cell Cleanout
Type 2 Review

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EXECUTIVE SUMMARY

This technical review examines the advisability and feasibility of removing cast iron hot cells from the 327 Building as intact units. This approach represents an important departure from the baseline, which currently includes a significant effort to decontaminate, dismantle, and package the cells and their appurtenances. The review team strongly recommends that management consider revising the baseline to adopt this alternative. The benefits from this new approach are lower cost, greater progress toward final end state, and reduced worker risk. This review was conducted for the River Corridor Project by Fluor Hanford Technology Management, which is managed by Battelle for Fluor Hanford, Inc.

The review team has high confidence that intact removal of the 327 Building hot cells is technically viable and provides a more desirable end state than the existing baseline. Analyses of implementation risks and estimated costs show that the risks of intact cell removal are no greater than the existing baseline and have the benefit of reducing the baseline cost by $2 to $4M. Key contributors to the estimated cost savings include eliminating a new liquid waste handling system as well as the resources necessary for removal and disposal of in-cell equipment, cell floor liners, and manipulators. The greatest uncertainty in the alternative is the effort required to achieve certification of the cells as non-transuranic waste. This characterization and decontamination work precedes any actual cell removal and, as such, minimizes unrecoverable investment until the alternative is proven viable.

Current and past plant personnel, including one of the original design engineers who witnessed construction and startup of the hot cells in the 1960s, confirmed the feasibility of this approach. In addition, informal discussions were held with contractors, regulators, and Hanford Site disposal facility management. While results of the review support the conclusion that all hot cells can be disposed of as non-transuranic waste, execution of this strategy requires that a comprehensive characterization of the hot cells be planned and implemented to successfully verify three conditions that form the technical basis for the recommendation:

- These hot cells can be disposed of as non-transuranic waste.
- The current physical condition of the cells and interfaces to the building can be established; in many cases, this entails confirmation of "as-built" information.
- The source terms can be confirmed to be within the safety basis envelope of an existing onsite Safety Analysis Report for Packaging (SARP).

The development of this alternative included a review of hot cell configurations, contamination levels, source terms, and associated plant authorization basis documentation. A step-by-step scenario was developed to identify key steps for implementation, provide a technical basis, and identify alternatives and issues to be addressed during the preconceptual phase of the deactivation project. The first step is to characterize and designate the waste category for the hot cells because this will impact all subsequent activities. The subsequent steps will employ commercial practices and services for lifting, handling, packaging, and transport that are readily available in the marketplace. Disposal facilities at the Hanford Site can be used for final disposition of the hot cell packages.

The review team recommends that the River Corridor Project take the following near-term actions as first steps in re-planning the 327 building baseline:

- Prepare an integrated characterization plan to confirm the waste designation for the hot cells, the physical configuration of cell interfaces, and the source term for transport packaging.

- Complete an engineering study to
  - ➢ select the method for internal and external transport of the cell package
  - ➢ provide additional definition of the transport package and associated jacking/support fixtures
  - ➢ assess potential 327 Building floor loading issues
  - ➢ identify building modification scope and associated impacts to the safety basis.
- Initiate the process to dispose of the hot cells in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements.
- Prepare a more detailed cost estimate and schedule.

1.0 INTRODUCTION

Successful completion of the Hanford Site cleanup actions within funding and schedule profiles will require programmatic risks and technical uncertainties to be identified and effectively managed. Periodically, independent reviews of project baselines are conducted under the direction of Technology Management organization, managed by Battelle on behalf of Fluor Hanford. These activities assess the viability of current planning and the integrity of associated technical bases.

The recommendations from these reviews typically address technical uncertainties related to achieving project objectives and identify alternative ways to achieve objectives, capitalize on opportunities, manage current baseline resources, mitigate risks, and apply alternative methods and technologies. Some of the reviews focus on execution strategies (Type 1 reviews), while others focus on tactical issues (Type 2).

This document describes the results generated during the Type 2 review of the project to stabilize and deactivate the 327 Building with specific emphasis on methods to remove hot cells A through I intact and to disassemble and stabilize the Special Environmental Radiological Facility (SERF) cell, including methods for removal of the nitrogen recirculation system. Fluor Hanford Technology Management established the review team, which consisted of experts and consultants from a variety of organizations.

2.0 SCOPE / BACKGROUND

Construction of the 327 Building was completed in 1953 in the 300 Area of the Hanford Site. The building played a key role in the metallurgical and fuel research programs for the site and includes nine shielded hot cells, a fuel basin, dry sample storage facilities, a large nitrogen inerted hot (SERF) cell, and office space. In 1996, the 327 Building was transferred from Pacific Northwest National Laboratory (PNNL) to Fluor Hanford to begin the transition from the historical missions of irradiated fuel examination and waste technology research to stabilization and deactivation.

The *324/327Buildings Stabilization/Deactivation Project Management Plan* (Johnson 2000) provides the baseline plan for how these buildings will be transitioned to a safe and stable condition requiring minimal surveillance and maintenance. In August 2000, a Type 1 review of the activities and plans to stabilize and deactivate the 327 Building was completed. This provided insight into the technical challenges faced by the project and identified a potential opportunity to modify the baseline strategy by removing each of the hot cells in one piece instead of dismantling them (Kosiancic 2000).

In January 2001, this review team was assembled to conduct a Type 2 review of the concept of intact removal of hot cells “A” through “I” and to review planning for stabilization and deactivation of the SERF cell and the associated inert gas system. The statement of work for this effort is provided in Attachment 1.

3.0 REVIEW APPROACH

Review team members:

- Donald E. Ball — Remote systems, project definition and execution
- Paul T. Day — Regulatory Compliance
- Bruce D. Groth — Decontamination and stabilization
- William G. Jasen — Characterization, waste package certification
- Marlin R. Lindquist — Structural analysis
- Richard J. Smith — Transportation and packaging
- James D. Thomson — Team lead, project management, facility restoration
- James C. Wiborg — Safety basis and hazards assessment

Information on team member qualifications is provided in Attachment 2.

Initially, the team reviewed the results of the earlier work as well as reference information associated with program planning, characterization of the facility, risk assessments, safety and technical bases. Prior to the briefing with the 327 Building management, a team meeting was held to assign areas of responsibility and develop a general line of inquiry for the review. This served to identify potential areas of focus that were considered critical. Several groups of drawings were reviewed; these are summarized in Attachment 3 with team observations noted. Typical focus items included waste characterization, precedents for transport and burial large packages, and areas where additional information would be required by the team such as structural configuration of facility and waste characterization. Team assignments were made to further explore these topics prior to the briefing.

A briefing was given by Ray Stevens and Dale Dutt and included a tour of the 327 Building. The team review then began with identification of key issues, requirements, and facility interfaces. As a more complete understanding of the problem evolved, a recommended path forward was established by describing an assumed "process" for implementing the intact cell removal concept. The desired end state was defined as were the preferred attributes of an ideal process, beginning with the current cell configurations and ending with disposal on the Hanford Site. Development then progressed by assuming enabling conditions for implementation. Adjustments were made until all conditions identified could either be verified with available information or judged to be verifiable pending successful completion of follow-on actions. Actions requiring further disposition are identified in this report with recommendations for follow-on actions for verification.

The recommended hot cell removal process was broken down into discrete steps and is described in detail in the following sections of the report. Assumptions for each portion of the process are described as appropriate. In some cases, several alternatives were identified for a particular implementation step. Although available time and information for the team was limited, efforts were made to bound the recommended implementation strategy. For example, cells "A" through "I" are all constructed of the same high-density cast iron material. Some, however, are supported on steel pedestals and others are positioned directly on the canyon floor. Architectural drawings of the cells were reviewed to ensure that the proposed method to lift, package, and transport the cell was feasible for both cell types, but an in-depth review of all cells was not completed. Consequently, follow-on actions are identified. Using a similar approach, alternatives were considered for stabilization and disposal of the SERF cell and the associated nitrogen recirculation system.

A close-out briefing was conducted with 327 Building management and U.S. Department of Energy (DOE) representatives to review the team recommendation for implementation of the proposed process and to describe identified action items to close open issues.

Implementation risk and cost assessments were conducted for the intact cell removal recommendation and compared with the current baseline. David A. Seaver from PNNL led the risk assessment process, and Jeffery M. LeMarr from Fluor Hanford, Inc., supported the cost-estimating work. The results of these activities are reported in Attachment 8.

4.0 RESULTS—CELL REMOVAL PROCESS DEFINITION

Intact removal of hot cells A through I and the upper portion of the SERF cell from the 327 Building has been determined to be feasible by this review team. The SERF cell is configured generally in an upper portion that is accessible for removal and a lower structure that is integral with the concrete structure of the building. Steps outlining the envisioned process are summarized in Figure 4.1. Initial cell cleanout and decontamination to levels that qualify each cell as non-transuranic (TRU) waste are seen as the key enabling assumptions supporting this determination. Characterization efforts to date indicate that only three cells, F, G, and upper SERF, present any challenge to this assumption. Data indicate that qualifying cells as non-TRU waste is feasible or that a minimal decontamination, if required, can achieve a low-level waste (LLW) status. For other low-level mixed wastes, a disposal path is available.

As depicted in Figure 4.1 and detailed in this section, each cell would be cleaned out, decontaminated, and characterized in preparation for isolating and disconnecting it from existing piping and ventilation. Following isolation of the hot cell penetrations, a structural or reinforcing package would be attached to the outside of the cell to ensure its stability for lifting, transport, and disposal. The cell would be hydraulically jacked from its foundation and its bottom surface sealed and then packaged for transportation and burial. The packaged cell would then be lowered onto an internal transporter for movement out of the canyon. The penetrations in the canyon floor left from hot cell removal would be sealed or prepared for removal of the remaining hot cells. Once out of the canyon, the cell package would be moved onto an over-the-road trailer for transport to a disposal facility in the 200 Area. The transfer would take place inside a temporary structure erected at the east end of the canyon to act as an airlock. Transport to the burial grounds and off-loading there would be handled as a special-case low-level waste package. In the event that a cell cannot be designated as non-TRU, no path for disposal has been identified. This eventuality is discussed briefly in Section 4.8.

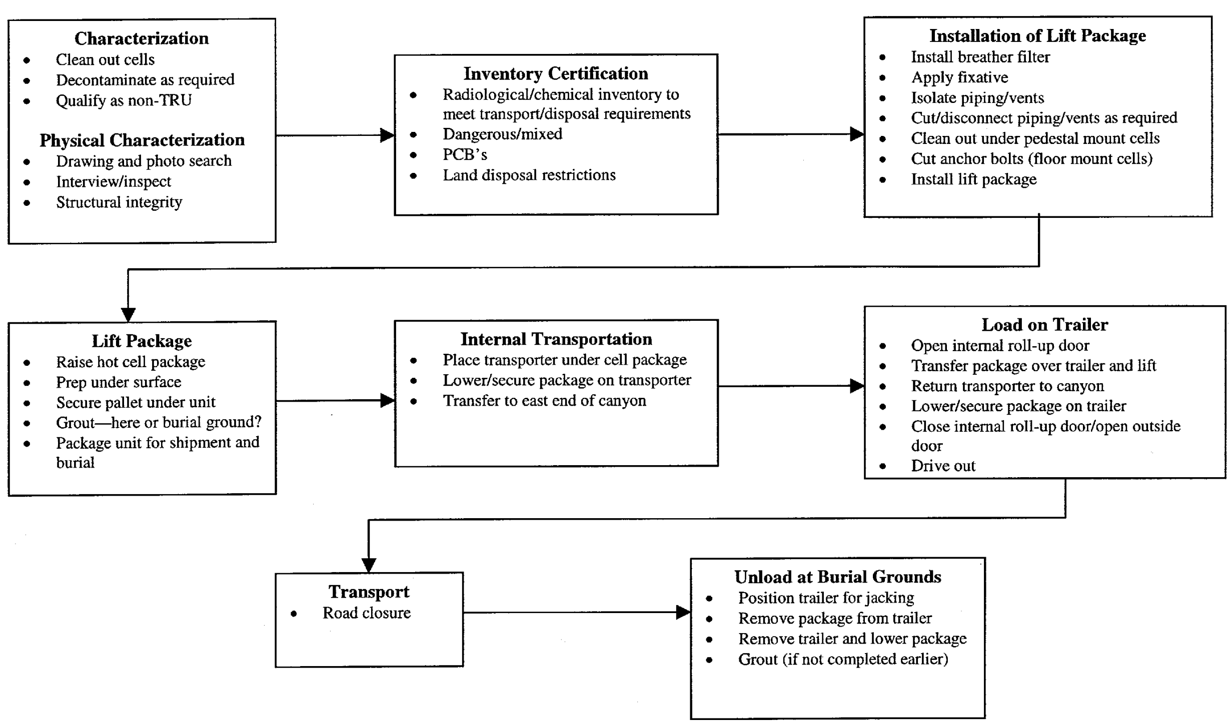


Figure 4.1. 327 Building Cleanout Process Flow Summary

4.1 Characterization/Decontamination

The recommended strategy is predicated on the assumption that the hot cells can be qualified as non-TRU waste. Existing characterization data were reviewed and found to be insufficient to certify a waste designation. A sample and analysis plan will be required to support waste designation of the hot cells. If the hot cells cannot be designated as non-TRU waste, the cell interior will need to be decontaminated to reduce radionuclide levels below TRU concentrations (see Attachment 5). However, based on the assumptions and discussion in this section, it was concluded that all the hot cells can be designated as non-TRU waste. Three issues were identified for further review:

> ***The quantity of radionuclides entrained in the painted layers on the interior surface of the hot cell walls is unknown.*** *Resolution of this issue will require additional sampling and analysis. A sampling and analysis plan will be required to obtain a representative sample of the paint and perform radiochemical analysis to determine the radionuclide content. Alternatively, a nondestructive assay technique might be applied from the interior of the cell in situations where the background radiation is low.*
>
> ***Activation products or contamination entrained in the steel walls is not quantified.*** *Resolution of this issue will involve verifying that steel walls do not contain activity levels that would preclude onsite disposal. In a conversation with Cecil Boyd,*[a] *it was confirmed that the cell interiors were painted prior to hot operations. This supports the assumption that the steel walls should not have entrained radionuclides.*
>
> ***Radionuclide and chemical characterization of the void space between the hot cell floor and the facility floor are unknown.*** *Resolution of this issue will require additional sampling and analysis. A sample/analysis plan (see above) will be required to obtain representative sample from this area and quantify the radionuclide and chemical inventory.*

DOE Order 435.1 addresses radioactive waste management. The manual for that order (DOE M 435.1-1) contains the definition for TRU waste and provides a number of examples, one of which describes a situation in which solidification of a TRU waste is required to enable shipment and disposal. The solidified waste could be recertified as LLW after treatment if radioassay found that the solidification process reduced the concentration of relevant radioisotope to less than 100 nCi per gram of waste matrix. It is likely that the void space in the hot cells will need to be filled to meet waste disposal criteria. A dense or heavy grout may be used to fill the void rather than lightweight structural foam. The grout would affect the TRU concentration. The DOE order states that dilution of a TRU waste stream to reclassify the waste as LLW (reducing the concentration to less than 100 nCi/gram) is not permitted. The selection of a material to fill the void should be based on meeting disposal and packaging criteria and not to reduce the TRU concentration. Burial criteria typically require the void space to be minimized

This example also states that the waste determination should not consider the container or its rigid liner. Any container or liner determined necessary to facilitate transport or disposal would be excluded from TRU

(a) Personal communication with Cecil Boyd, retired Hanford employee who was responsible for many of the drawings that were used for this review. January 31, 2001.

concentration calculations. For example, a TRU waste is placed in a 55-gallon drum with a rigid liner. At the time of radioassay, the weight of the drum and liner is excluded and the TRU concentration is determined based on the net weight of the waste.
The activity concentration of TRU radionuclides present in the waste (nCi/g) must be determined to demonstrate that the waste meets the definition of TRU waste. For TRU wastes, the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria (WAC) (DOE 1999) require the following radionuclides, ^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr, and ^{137}Cs to be quantified. For TRU waste, the quantity of each radionuclide listed above must be reported. However, only alpha-emitting transuranic isotopes with half-lives greater than 20 years are used in calculating the TRU concentration (>100 nCi/g). Uranium, neptunium, cesium, and strontium are not TRU elements. Due to known fuel examination process history and the presence of different types of fuel and materials, it is recommended that the additional radionuclides ^{237}Np, ^{242}Cm, ^{243}Cm, and ^{244}Cm be analyzed. For low-level waste, other isotopes, including ^{54}Mn, ^{60}Co, ^{125}Sb, ^{134}Cs, ^{154}Eu, ^{155}Eu, ^{94}Nb, ^{106}Ru/Rh, and ^{226}Ra, are of interest. Trace radionuclides (less than 5 percent of the total activity) need not be reported, as long as the calculation accounts for 95 percent of the total container radioactivity.

Nondestructive assay (NDA) techniques are not expected to directly identify and quantify all the individual radionuclides in the waste matrix of the hot cells. Process knowledge, direct measurements using relative gamma spectrum analysis, or radiochemistry may be used to determine isotopic ratios for unmeasured radionuclides. These isotopic ratios, in conjunction with NDA, may be used to calculate the quantities of unmeasured radionuclides.

Based on available data and assumptions, a waste designation has been estimated for the hot cells. It is assumed that the remaining inventory of 30 metal cans of waste material (currently in the hot cell) would be removed for disposal before designating the hot cell as waste. It was also assumed that the lead shielding around or beneath the hot cells will be certified as continuing to serve the shielding function or be removed and disposed of separately from the hot cells. The draft BIO (FH 2000a) states the plutonium holdup in each hot cell is 10 to 15 grams. For a preliminary waste designation, a conservative assumption was that the 15 grams of plutonium are ^{239}Pu and 0.5 percent (0.075 grams) is ^{241}Am. On that basis, each cell would then contain 1.19 alpha curies.

$$15 \text{ g } ^{239}\text{Pu} * 0.062 \text{ Ci/g} + 0.075 \text{ g } ^{241}\text{Am} * 3.43 \text{ Ci/g} = 1.19 \text{ Ci}$$

Table 4.1 presents a waste designation for each cell based on this assumed scenario. Although intended to be conservative, this designation is based on information contained in the draft BIO, which is not yet approved for use. For all the cells, a 15-gram plutonium inventory results in a TRU concentration less than 100 nCi/g and a LLW designation.

Landsman et al. (1998) state the radiological status of B and H cells as having no alpha contamination per 100 cm^2, yet Table 4-1 in that document reports a small quantity of ^{241}Am for these cells. This small quantity of americium is not sufficient to consider any of the hot cells a TRU waste. Even in F and G cells, where the highest levels of contamination were identified, a LLW designation would still be indicated. However, that document quantified radionuclides based on smearable contamination and did not provide information on the quantity of radionuclides contained in the painted layers on the cell wall or entrained in its metal surface. Also, should decontamination of the cell be required, Landsman et al. (1998) provide an estimate of the quantity of contamination that could be easily removed by simple decontamination methods such as dry wipes (see Attachment 4). Additional decontamination, if required, would need to remove the layers of paint.

Table 4.1. Calculated nCi/g Concentration Based on 15 g Plutonium and Quantity of Am-241 Needed to Cause the Cells To Be Designated as TRU Waste

Cell	Estimated cell weight (tons)	Estimated cell weight filled with grout (tons)	Estimated nCi/g based on 15 g Pu^{239} and grouted cell weight[(1)]	Grams of ^{241}Am required to be designated as TRU waste	Size, ft[(2)]	Wall Thickness, in.
A	155	180	7	4.8	9.5x4.5x8.17	18
B	60	70	19	1.9	6x4.3x4.3	15
C	40	45	29	1.2	6x4.3x4.3	10.5
D	40	45	29	1.2	6x4.3x4.3	10.5
E	40	45	29	1.2	6x4.3x4.3	10.5
F	145	170	8	4.5	8x5x8.17	18
G	95	135	10	3.6	10.25x6.25x8.3	10.5
H	50	60	22	1.6	5.3x4.6x7.1	10.5
I	35	40	33	1.1	4.3x4x5.17	10.5
Upper SERF	160	196	7	5.2	12x5x5	15-18

(1) Simple volume and weight calculation, cast iron density = 442 lb/ft^3.
(2) Interior dimensions; last dimension is height (Landsman et al. 1998).

Additional data will be required to quantify radionuclides in each cell and make a formal waste designation. The amount of americium and curium must to be determined. Americium and curium are of particular importance due to the impact on designating TRU waste. Table 4.1 also shows the small gram quantity of americium that would be needed in each cell to cause the cell to be designated a TRU waste. This would violate the underlying premise of this recommendation from this review and preclude intact hot cell disposal.

4.2 Inventory Certification

An official or certified inventory for the hot cells is not currently available. Certification of the waste inventory will use a graded approach of applying data quality objectives and statistical based representative sampling to quantify radionuclide and physical characteristics of the waste. A few alternative methods are proposed to minimize sample and analysis costs. Sampling and analysis must be performed to determine, quantify, or verify the following items:

- Characterizing radiological inventory to meet disposal requirements.
- Characterizing physically or chemically to meet treatment-, storage-, or disposal-specific requirements.
- Determining that a waste meets applicable land disposal restrictions.
- Determining whether the waste is regulated for PCBs.
- Determining applicable waste codes (if any) from Washington Administrative Code (WAC) 173-303.
- Establishing a design-basis source term to determine transport package requirements.

Based on process knowledge of the activities conducted in the hot cells and acceptable knowledge of the waste handling activities, there is little indication that hazardous constituents are present. During this review, it was stated by facility personnel that the hot cells do not contain any known hazardous constituents. If there is no indication of hazardous constituents, further analysis for hazardous constituents is not warranted. Facility representatives need to document process/acceptable knowledge of the activities in the cells and attest to the physical and chemical conditions in order to certify the waste designation. Based on a conversation with Cecil Boyd,[(a)] the hot cell interior walls were painted with Amercoat paint prior to hot operations. The paint will need to be sampled and analyzed for certification of the waste designation since it has the potential to contain lead and chrome.

Lead shielding is present at the base or in the space between the cell floor and the facility floor. After the remaining waste inventory is removed from the cells (currently 30 metal waste buckets/paint cans remain) the shielding may no longer be needed. If it is no longer needed, the shielding should be handled and disposed separately from the hot cells. Other lead sources (e.g., lead wool packing around the windows) were noted for the SERF cell.

The graded approach used to plan and implement sampling and analysis requirements will require specific and, in some cases, rigorous quality assurance and extensive documentation. Other requirements, such as field screening to confirm process knowledge about a waste stream, may not require the same level of quality assurance. Quality levels will be determined for each characterization decision and controlled through data quality objectives.

Data quality objectives will be established to ensure that the correct type, quantity, and quality of data are collected. These may involve general information, waste specific parameters, and characterization objectives such as analyzing paint for lead or chrome, and process knowledge. The objectives must clearly define the purpose for the characterization activity, the decisions to be made, the parameters and constituents of concern, a decision rule, and allowable decision errors. The purpose of sampling and analysis is to quantify the radionuclide concentration sufficiently to support a waste designation, transport of the hot cells and waste disposal. For example, alpha emitting isotopes with half-lives greater than 20 years are the target constituents for TRU waste, and the decision rule will be to verify concentrations below 100 nCi/g.

One alternative for quantifying the TRU may involve new applications of existing technologies such as inserting neutron or gamma detectors into the cell through a protected sleeve (NDA 2000). Using an existing port on the side of the hot cell, an axial array of detectors would be deployed along one central axis of the cell or a shielded detector oriented toward the cell wall. Although invasive, this technique might provide NDA of the radionuclide content of the cell or cell wall. When the NDA has been completed, the protective sleeve would be left in the cell as waste and the detectors reused on the other cells. Deployment of this technology would require development of an engineered system for application to the 327 Building hot cells. In addition, the high background radiation from cesium and strontium in F and G cells would swamp the detectors and make this technique unusable in cells with high activity.

Another approach might involve grouping the hot cells into similar process categories. Based on process knowledge, the nine hot cells might be grouped into two or three categories based on expected radionuclides. Based on available documentation, B and H cells, with minimal alpha contamination, might form one category. A sample and analysis plan would be designed to quantify the dose and radionuclide concentrations of the worst cell in each category. Multiple representative samples from the same cell could be composited to

(a) Personal communication with Cecil Boyd, retired Hanford employee who was responsible for many of the drawings that were used for this review. January 31, 2001.

minimize analysis cost and the results averaged over the entire surface of the cell. The results of the analysis could be scaled to the other cells as a worst-case estimate, avoiding costly analysis of each cell.

Characterization data are not available on the area between the hot cell floor and the facility floor. In some cases, this area is accessible and does not appear to add to the facility radionuclide inventory significantly or pose an issue for characterization. For cells on a pedestal, like C cell, this is not an issue because it will be cleaned out and disposed separately from the hot cell. In others, such as A cell, this space is not readily accessible and the radionuclide inventory is unknown. In at least two cases, there are documented occurrences (F cell and SERF) that may have contaminated these spaces. Smears/surveys or radioassay of these areas will need to be obtained to quantify the inventory.

Effective characterization is required to establish the technical basis for disposal at a particular regulated area on the Hanford Site. A description of each area considered is provided in detail in Section 4.8 of this report.

4.3 Isolate Cell and Install Lift Package

The nine hot cells in the 327 Building are constructed of Meehanite cast iron blocks each with massive sides, tops, and bottoms. Meehanite is a special process cast iron that has uniform density and consistent physical properties. The material has a tensile strength of 25,000 to 55,000 lb/in^2. Because it is a cast iron, Meehanite is not a high-ductility material; however, loading effects on the cell structure can be managed to keep the risk of brittle fracture low. As is discussed in Section 4.4, a protective structure will be built around the cell that will minimize external loading and securely contain the structural elements that make up the cell unit. If necessary, this external structure may be pretensioned to reduce tensile stresses in the Meehanite blocks. Additionally, critical jacking and initial lifting of the cell will be accomplished within the 327 Building, where temperatures can be maintained at a moderate level. Based on the discussion and assumptions in this section, the recommended removal option is feasible with one issue identified.

> ***Physical characteristics of the hot cells need to be inspected to confirm as-built cell and facility interface configurations—****This is necessary to establish a technical basis for isolation and intact removal. This should be addressed when the characterization plan is developed (as discussed in Section 4.1).*

The general cell configurations can be grouped into two categories:

- Cells A, F, G, and H rest directly on the concrete floor of the building. Anchor bolts through the base secure the cell to the floor.
- Cells B, C, D, E, and I (referred to as pedestal cells) are raised above the floor and supported by structural steel posts. The base of the cell is approximately 24 inches above floor level. The posts are secured to the floor with concrete anchor bolts. Approximate weights of the cells are shown in Table 4.1.

4.4 Lift Package

This section provides a discussion about preparations to lift the cells and package them for transport.

4.4.1 Lift Package for Cells with Base Resting on Floor

Cell assemblies A, F, G, and H are of similar construction and consist of a number of rectangular cast iron blocks that form the sides, top, and bottom of the cells. Cell A is typical. It consists of

- Front–2 pieces, left and right
- Rear–6 pieces, upper, lower, left, right, and center (consists of 2 pieces)
- Left/right sides–2 pieces each, upper and lower
- Bottom–2 pieces
- Top–2 pieces.

The front, rear, and side blocks form the walls and nestle around the base. They are held together at the corners with 1½-inch bolts in tapped holes. They are attached to the base with a number of horizontal 1½-inch bolts that are secured in tapped holes in the cell base. The base is anchored to the floor with 1½-inch anchor bolts that are located approximately 12 in. from the edge of the base. The blocks that form the upper portion of the walls are placed on the lower side and end blocks and held in position by alignment pins at the upper/lower block interface. These blocks are also bolted together at the corner edges.

The concept for lifting the floor-mounted cells will be to encase the cell in an external framework of structural steel members that "capture" the cell as a unit and prevent the cast iron blocks from shifting or coming loose as the unit is lifted and moved (see Figure 4.2). The major horizontal structural steel members around the lower portion of the cell unit will provide locations for jacking within the building and for lifting the unit later as needed. After the cell is released from its anchorage and lifted off the floor, a pallet or strongback will be placed underneath. This pallet will be attached to the other added external structure to provide the final lift package. The locations of the bolts that attach the cells to the base will be used to provide the structural tie between the cell and the exterior frame so that the unit can be lifted and the pallet placed underneath.

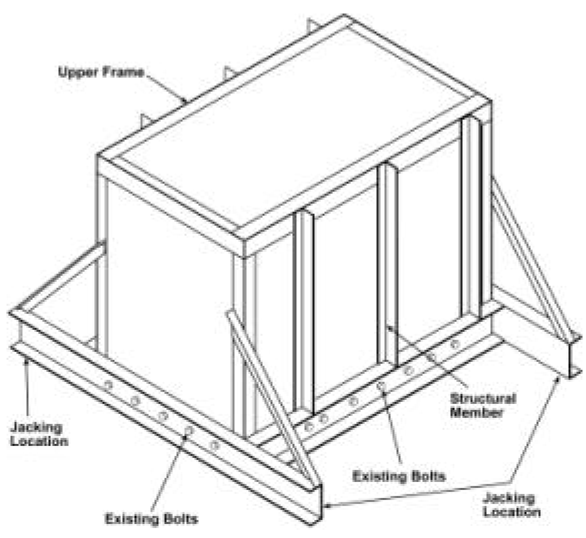


Figure 4.2. Hot Cell Package Concept (pedestal mounted)

The first major step in preparing the lift package will be to cut the anchor bolts that secure the cell base to the floor. The anchor bolts can be cut in several ways:

- Remove the concrete under the base to expose the anchor bolts, then cut them.
- Drill horizontally through the cell sidewall and base to penetrate and cut the anchor bolts.

- Saw horizontally at the cell base to separate the cell from the concrete floor interface.

Based on discussions with a vendor experienced in cutting reinforced concrete, horizontal sawing appears to be the most viable option at this time and offers predictable results. Cell drawings show the location and number of anchor bolts through the base. These drawings indicate that the anchor bolts are approximately 12 inches from the edge of the structure.

The next step in preparing the lift package will be to remove the sidewall bolts that thread into the cell base. Also, any small components that are mounted on the outside of the cell near the base should be removed for disposal. After the bolts are removed, a horizontal frame made up of structural members will be placed around the base. This frame should fit snugly around all four sides of the cell. The frame will be attached to the cell using the existing tapped and threaded bolt locations in the cell sidewall and base, as noted above. New, longer bolts will be used to achieve a higher shear-strength material and provide sufficient thread engagement. The frame will have extended outriggers in the north-south direction to use later as jacking locations.

Cell drain lines and heating and ventilation lines pass out of the cell through the base and go through the concrete floor. An examination of drawings shows that, for the cells investigated, these lines are straight (vertical). If the lines are slanted or have elbows imbedded in the concrete, cell removal may be more complicated. The drain lines and heating and ventilation lines must therefore be characterized and isolated so they can be cut. The internal surface area of the cell near the base may need to be foamed or grouted to reduce contamination as the lines are cut. The lines may be cut with an internal tool or with external tools and can be accessed from the basement or interior of the cell.

Additional steel structural framework will be added to the top of the cell and to the vertical corners to stabilize the cell wall and keep the top blocks from moving. Finally, the upper and lower frames will be joined together with additional members to keep the individual blocks from shifting while the cell is being handled. The cell is now ready to be lifted from its attachment to the floor.

4.4.2 Lift Package, Pedestal Cells

Cell assemblies B, C, D, E, and I are also constructed of a number of rectangular blocks that form the sides, tops, and bottoms of the cells. These cells are similar in concept to cells A, F, G, and H except that they are smaller and are raised above the floor on structural steel posts.

The front, rear, and side blocks nestle around the base and are held together with 1½-inch bolts in tapped holes. As with cell assemblies A, F, G, and H, the walls are attached to the base with a number of horizontal 1½-inch bolts in tapped holes. The vertical posts that support the cell are attached to the floor with concrete anchor bolts.

The concept and procedure for lifting the pedestal cells will be similar to those used on the cells that rest directly on the concrete floor. An external framework will be added to structurally encase the cell, and the bolts that fasten the sides of the cell to the cell base will be used to secure the lower part of the horizontal lifting frame to the cell unit. The framework will have outriggers in the north-south direction to accommodate jacks. Some of the pedestal cells have had additions that should, if possible, be removed to accommodate the framework.

The components that are underneath the cell should be characterized and removed for disposal. Drain lines and heating and ventilation lines that protrude under the cell should be characterized, isolated, and cut flush with the base. Characterizing and cutting of the drain and lines should be less difficult for the pedestal cells than for the cells that rest directly on the floor because the region under the cells is open and accessible. Releasing the cell from its attachment to the floor will also be less difficult for these cells than it will for those that are attached directly to the floor. The vertical support posts will be cut where they attach to the cell base. The cell package is now ready to lift.

4.4.3 Lifting the Package

Lifting procedures will be similar for all of the cells. The cell package will be lifted by using a jack on each corner. The jacks will be fitted with load cells to ensure that

- The loads are evenly distributed.
- The loading on the building concrete floor is not excessive.
- The cell is free from any attachment to the building floor.

Care must be taken in placing the jacks (and later, during internal transport) to ensure that the building floor loading is not exceeded. Current limits on floor loading are 20 tons on a 3 by 3-ft area or 350 lb/ft^2 uniform load on a 16 by 16-ft area. If it is anticipated that the loading on the floor will be exceeded during jacking and internal transport, one or several of the following may need to be accomplished:

- Structural analysis to further confirm the allowable floor loading
- Added structure that allows the jacking and transport locations to span a larger floor area
- Local shoring for the floor from beneath.

At this point, the package could be lifted. The load cells would be monitored to ensure that no attachment of the cell package to the floor remains. The cell package would be lifted just high enough to verify that the unit is clear of the floor. Any contamination present under the cell should be addressed at this time.

Next, the unit would be lifted high enough so that the pallet could be placed underneath. Before placing the pallet, any protruding anchor bolt or drain line segments would be cut flush with the bottom surface of the unit. After the pallet is placed under the unit, the cell assembly and pallet would be lowered to the floor. The pallet would be attached securely to the structural members that have been added to the outside of the cell package. The inside of the cell could now be grouted if required and is ready for internal transport.

4.5 Internal Transport

To prepare for over-the-road transport (discussed in Section 4.7), the hot cell will be wrapped with reinforced plastic to meet applicable safety analysis requirements. It will then be moved to the east end of the building for removal. The east wall of the 327 Building will be modified to permit the addition of a rollup door that allows access to the large open area at the east end of the canyon (see Figures 4.3 and 4.4). To ensure that building confinement is retained, a metal-sided structure will be added to house the trailer that will transport the package to the burial ground. Details regarding required building modifications are provided in Attachment 4.

Several options are possible for moving the package, as summarized in Table 4.2. Further engineering studies will be required to select the best option. For example, discussions were held with Lampson (see Attachment 6), regarding their abilities to support this effort. This was used to establish one of the options for Table 4.2. Depending on the option selected, added structure can be provided to span a larger floor area or shoring from the floor beneath could be added if required (see Figure 4.5).

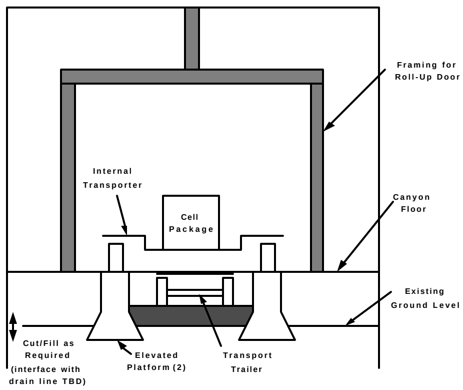


Figure 4.3. East End of the 327 Building Canyon

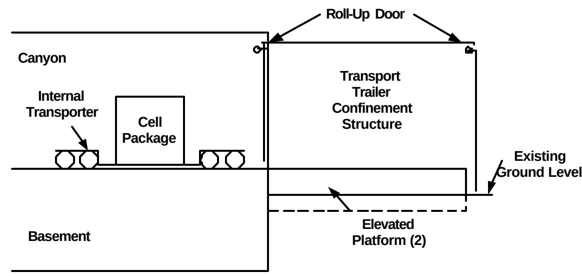


Figure 4.4. 327 Building Confinement Structure

Table 4.2. Options for Internal Transport

Option	Sub-Options
Custom transporter	• Low flatbed trailer that would be positioned under the jacked-up cell. When loaded, this trailer would be pushed or winched out of the building to a position above an over-the-road transport trailer, where the cell would be lowered with jacks. • A U-shaped low trailer that could be positioned around the cell. This trailer would contain jacking mechanisms that could both raise the cell off the canyon deck and lower it onto the transport trailer. • Either of these sub-options could be mounted on tires or rails.
Use of existing equipment	• It has been assumed that separate internal and over-the-road transporters would be used. However, Lampson could provide a 6-axle, 8-tire/axle trailer that could both remove the cell from the canyon and (at slow speeds-several mph) transport it to the burial site. It is approximately 32 x 12 x 5 ft (h) and weighs 33 tons. Axles are self-powered and steerable. Also, the bed can be lowered 2 ft, which would simplify off-loading at the burial ground. It appears that this configuration would stay within current floor loading limits. • A smaller, 4-axle 24-ft trailer is also an option with Lampson. However, this particular unit is not available at this time.
Drag or roll	• A simple flat plate is put under the cell and pulled using rollers or a low friction surface such as Teflon. These options are used by Lampson for moving heavy loads over short distances. In this way the cell would be positioned over the transport trailer and lowered onto the deck.

4.6 Placing the Cell on the Over-the-Road Transport Trailer

As described in Attachment 4, a structure, or temporary airlock building will be constructed abutting the east wall as a confinement area to house the over-the-road trailer that will transport the packaged cell to the 200 Area disposal facility. This building will provide confinement when the roll-up door in the canyon wall is opened and the packaged cell moved out of the canyon for loading onto the over-the-road transport trailer. A trailer access door at the east end of the building completes the confinement features (see Figures 4.4 and 4.6). Table 4.3 shows the advantages of using the east end of the canyon for the temporary airlock building.

A ramp or two elevated platforms at canyon floor height would allow access to the facility for the Lampson 6-axle trailer or permit positioning of the over-the-road trailer in preparation for lowering of the cell package onto it.

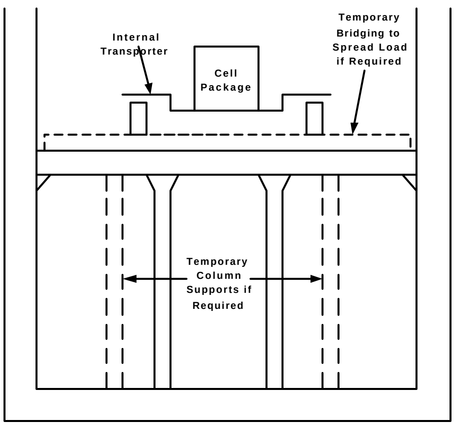


Figure 4.5. 327 Building Cross-Section

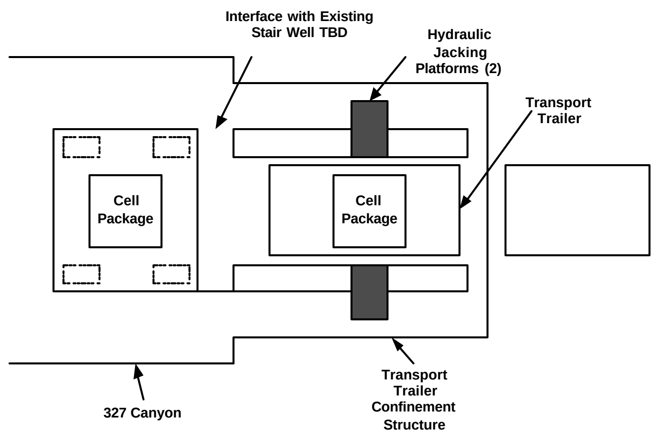


Figure 4.6. 327 Building East End Plan

Table 4.3. Options for Locating the Temporary Airlock Building

Option	Key Features
East end	• No obstructions inside canyon • Large open area outside canyon. Over 100 ft clear to road. • Straight line movement for all cells except SERF • Allows smaller cell, I, to be moved first • Modifications to facility not judged significant
West end	• Significant obstructions—wet/dry basins, decon cell, and stack • Truck lock restricted in width • Access outside for heavy equipment restricted • Heavy cell, A, first to move
North side	• Confinement structure would block road to north • Most cells would require 90-degree rotation to remove • Heavy cell, SERF, first to move

4.7 Hot Cell Transport

Each individual hot cell package will be transported by a heavy haul transporter from the 327 Building to a 200 Area disposal location, a distance of approximately 25 miles. The specified transporter will be of adequate capacity and design to accommodate the high concentrated weight of each hot cell and shall include a sufficient number of axles to meet roadway-loading limits. It is likely that the transport will take place at very low speed. The hot cell package shall be secured to the transporter with an engineered tiedown system to ensure the stability of the package and the transporter.

Because the hot cell will be packaged and shipped in accordance with an onsite approval document rather than the Department of Transportation (DOT) regulations, the road between the 300 Area and the Wye Barricade must be closed to public access during transport, as specified by *Radioactive Material/Waste Shipments* (Fritz 2000). The general packaging and transportation requirements needed to meet the proposed authorization basis alternatives are discussed in more detail in Section 5.2.

4.8 Disposal Location

The goals for disposal of the hot cells in the 327 Building are to ensure worker safety and environmental compliance, provide long-term environmental protection, and minimize costs. These goals are achievable through the use of available disposal facilities at the Hanford Site.

Options considered were developed on the assumption of intact disposal of each hot cell and the upper portion of the SERF cell (see discussion in Section 6.0). This is the preferred method of disposal because it provides an added level of protection for worker dose and contamination during the disposal process. Effective turnover to operations after transport to the final disposal location will require early planning and interface management to ensure the transfer is accomplished in a systematic and orderly manner.

Five disposal facilities in the 200 Area of the Hanford Site were evaluated in terms of physical viability and programmatic aspects. These disposal options are shown in Table 4.4. Each option is discussed in more detail later in this section.

Based on information available at this time, the recommended disposal facility for the 327 Building hot cell packages is the Environmental Restoration Disposal Facility (ERDF). The ERDF is available today, has significant flexibility for disposal operations, provides the required treatment capability onsite and the highest level of design to protect the environment, and typically has the lowest disposal costs of any onsite facility. Both U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) support the use of the ERDF as the onsite facility of choice to dispose of cleanup waste. The ERDF was designed and constructed to dangerous waste disposal facility standards and has the equipment to perform in situ grouting for disposal. The administrative tasks of completing the required Engineering Evaluation/Cost Analysis (EE/CA) and Action Memorandum are minimal. Development of the necessary agreements with the Environmental Restoration Contractor to receive this type of waste are minimal and can be conducted while there is ample time—during the project planning phase.

Table 4.4. Disposal Facilities Evaluation

Disposal Facility	Facility Description
Environmental Restoration Disposal Facility (ERDF)	• Limited to receipt of CERCLA cleanup waste • CERCLA decision document must be issued to authorize disposal • Double-liner system with leachate collection and leak detection
Canyon Facilities (option potentially available in 2002)	• Deactivated canyon facilities (e.g., U-Plant, B-Plant) • CERCLA decision document must be issued to authorize disposal • Concept: fill canyon with waste and then entomb entire facility structure • Could be available to receive waste in about two years if "concept" is determined to be feasible
Low-Level Burial Grounds (LLBG)	• Designed under RCRA and State criteria to receive low-level waste only (no dangerous waste) • Trenches not required to be lined.
Mixed Waste Trench	• Designed to receive dangerous waste and dangerous/low-level (mixed) waste • Double-liner system with leachate collection and leak detection
Submarine Trench (option determined to be infeasible)	• Limited to disposal of U.S. Navy nuclear submarine reactor compartments • Trenches not required to be lined.

The option for onsite disposal of the hot cells is available only if the hot cells are not designated TRU waste (see discussion in Section 4.1). In the unlikely event that any of the hot cells do designate as TRU waste, they would be left in place until packaging and disposal options became available. One alternative would be the Central Waste Complex (CWC) , although details regarding this would need to be further investigated (e.g. CWC floor loading). Preliminary data indicate that the hot cells will not designate as TRU waste and that onsite disposal is a viable option.

Certain activities related to disposal would be required irrespective of the disposal location selected. For example, characterization information will be required (see discussion in Sections 4.1 and 4.2) to the extent that both the generator and the disposal facility personnel are in agreement on radiation levels and on the type and level of contamination in the hot cell package. This would ensure that the disposal facility waste acceptance criteria are met and that no further treatment would be required before disposal. Disposal facilities require a percentage of waste be verified upon receipt. Due to the size, complexity, and inventory of the hot cells, verification upon receipt at the disposal location would not be possible; characterization would need to be done at the 327 Building. Disposal facility personnel should review the sampling and analysis plan and waste characterization process to ensure that all issues associated with disposal are addressed. Upon completion of all waste approval documentation, the waste package would be scheduled for transport to the disposal facility. Waste receipt at the disposal facility would be accomplished via a review of documentation and receipt surveys for dose and contamination.

The hot cell packages will all be very similar, although it is possible that they could differ in final waste designation (see discussion in Section 4.2). This could result in an option to dispose of certain hot cells at one disposal facility and others at another. Tradeoffs in using multiple disposal facilities will need to be considered when characterization is complete. However, it may be advantageous to select a single disposal facility for all the hot cell packages so only one pathway and process has to be implemented.

There is a possibility that at least one of the hot cells contains lead that will remain permanently. Ecology's position on disposal of submarine reactor compartments is that lead is not a solid waste as long as it performs its original purpose of shielding radiation. However, Ecology believes that once lead is buried, it no longer provides its original purpose, shielding, and therefore is considered solid waste. As solid waste, the lead designates as a dangerous waste, with a D008 waste code. In this situation, lead is a dangerous waste only under Ecology definition. The EPA does not consider lead used for shielding as a waste, even after disposal.

In the event that lead or other dangerous or mixed waste is to be disposed as part of the hot cell packages, the hot cells would be subject to both Washington Administrative Code (WAC) 173-303 requirements and the land disposal restriction requirements of 40 CFR 268. This would eliminate the option of disposal at the low-level burial ground. DOE-RL may not wish to establish the precedent of designating equipment such as these hot cells as dangerous or mixed waste. The hot cells would need to be designated as dangerous or mixed waste to dispose of them in the mixed waste trenches.

All waste packages must be configured for safe unloading at the disposal facility. The preferred option for unloading the hot cell package at the disposal facility is to position the package onto engineered pedestals (similar to the one used for offloading submarine reactor compartments). An analysis of access limitations for each of the onsite disposal facilities has not been performed, although access limitations (e.g., load limits, ramp grade, and turning radius) are presumed not to present problems.

Engineering analysis of the hot cell package would be performed to qualify the stability or integrity of the package under disposal conditions. Grouting would be required to eliminate void spaces because the hot cell packages would not meet the definition of a high-integrity container. Grout could be added at the 327 Building before transport or at the disposal facility. Certain disposal facilities are better equipped than others to provide in situ grouting. If the hot cell packages are offloaded onto engineered pier blocks at the disposal facility, the void space beneath the bottom of the hot cell package and between the pier blocks could be grouted or backfilled to create a permanent monolith. Grouting the interior of the hot cell package to eliminate the void space at the disposal facility could optimize the grouting process and eliminate additional weight during transport.

The cost of disposal should be considered as part of the disposal pathway selection process. Disposal costs for routine wastes at on site facilities may vary by as much as a factor of 10. However, the hot cell packages will not be considered routine waste. Because disposition of the hot cells at any of the onsite facilities would require special handling of the waste package, standard disposal costs based on weight or volume would not be directly applicable. Each of the five disposal options evaluated is discussed below.

4.8.1 Environmental Restoration Disposal Facility

The option of disposal at the ERDF is available but would require the involvement of both the EPA and Ecology. The ERDF can only accept waste that is shipped under the authorization of a CERCLA decision document. An EE/CA for a CERCLA non-time-critical removal action could be developed, after which EPA and Ecology would issue an Action Memorandum authorizing disposal at the ERDF. Preparation of an EE/CA is not an extensive effort, and Action Memoranda have been issued in a timely fashion by the regulators in the past; so this option presents a viable pathway for disposal. A formal 30-day public comment period would be required on the EE/CA.

The hot cell packages should be able to meet all other ERDF waste acceptance criteria, as specified in BHI (1998). The ERDF can also accept dangerous waste or mixed waste, provided the waste is treated to meet the land disposal restriction requirements of 40 CFR 268. For lead, this would involve stabilizing the waste, which is usually done through grouting. The ERDF operations include in situ grouting as a routine service.

4.8.2 Canyon Facilities

The Canyon Disposal Initiative Feasibility Study is under way, with a final report due by September 30, 2001. Disposing of the 327 Building hot cells in a canyon facility was discussed with the Feasibility Study team and EPA and Ecology representatives. Interest was high in each case, and all parties agreed that this option should be explored further as the Feasibility Study progresses this year. As envisioned, the canyon facilities would be authorized to accept CERCLA cleanup waste similar to the ERDF, but they would typically receive higher-activity material and equipment that has a low probability of leaching hazardous constituents into the environment. The first canyon facility under consideration is U Plant.

EPA and Ecology will review the Feasibility Study and determine whether the Canyon Disposal Initiative should be used at the Hanford Site. If they concur with the use of canyon facilities for disposal, they will issue a CERCLA Record of Decision (ROD) by about December 2002, authorizing the receipt of waste. If this option were selected for disposal of the hot cell packages, an EE/CA and Action Memorandum would be required to direct the hot cell packages to the canyon facility. This CERCLA documentation would be the same as that required for disposal at the ERDF; a 30-day public comment period would be required.

The canyon deck appears to be the logical area for placement of the hot cells; however, other options such as placement in the railcar tunnel or even against the outside wall of the facility were discussed and considered viable. Access to the canyon deck would be gained by constructing a new entrance on one end of the canyon. A system of offloading the hot cell packages from the transport vehicle onto engineered pier blocks would be required because the canyon cranes are not rated to lift the weight of the hot cells. Floor loading on the canyon deck would need to be evaluated to ensure the deck could support multiple hot cell packages along with other waste planned for placement there. The dimensions of the railcar tunnel may be insufficient to accommodate access by the transport vehicle and the hot cell packages. The option of placing the hot cell packages on the outer wall of the building has certain advantages and drawbacks. Access would be very simple, but decisions have not yet been made as to whether such placement would be allowed or whether a double-liner system would need to be installed. If left in place, the canyons must be filled to eliminate the void space. Waste could be used for this purpose if it were combined with clean fill and grouted where necessary. The entire facility would be entombed at completion of the project.

4.8.3 Low-Level Burial Grounds

The option of disposal at the low-level waste burial grounds is available only if the hot cells are designated as low-level waste, not dangerous or mixed waste, under WAC 173-303. If hot cell characterization efforts reveal the presence of lead shielding or other hazardous constituents that cannot be removed, this option would not be available. If the hot cells are designated only as low-level waste, they could be shipped for disposal as part of routine operations, presuming all other low-level burial ground waste acceptance criteria are met as specified in the *Hanford Site Solid Waste Acceptance Criteria* (FH 2000b). As with the ERDF, grouting of the void spaces would be required.

4.8.4 Mixed Waste Trenches

The option of disposal at the mixed waste trenches (Trenches 31 and 34) is available if the waste is designated as dangerous or mixed waste, in accordance with WAC 173-303. The hot cells would be subject to the same land disposal restriction requirements of 40 CFR 268 as the ERDF. Waste treatment (other than grouting to eliminate void space) cannot be done in the trenches, so if treatment were required, it would need to be done at the 327 Building by the generator or at an approved treatment facility. In situ grouting can be done to eliminate void space, but the operation is not a routine service. The hot cell packages should be able to meet all other mixed waste trench waste acceptance criteria specified in FH (2000b)

4.8.5 Submarine Trench

The Submarine Trench in 200-East is managed by the DOE Navy Reactor Compartment Disposal Program and is dedicated to burial of only U.S. Navy nuclear submarine hulls containing reactor compartments. This trench offers easy access for very heavy loads. There is an inherent similarity between the intact hot cells and the submarine reactor compartments. There is no excess capacity in the trench at this time or in the foreseeable future because the available space in this trench is reserved for additional submarine reactor compartments. Additionally, burial of the hot cells would set a precedent for "other waste" to enter this disposal trench. Thus, disposing of the hot cell packages in the Submarine Trench is not considered a viable option.

5.0 AUTHORIZATION BASIS

5.1 Safety Basis

The current safety basis for the 327 Building was reviewed in the context of the proposed logic for proceeding with intact hot cell removal. Based on the discussion below it was concluded that:

- If the design provisions are made as identified, no significant safety concerns would result from the proposed operations for integral hot cell removal.
- A revised safety analysis would support the approach with no additional administrative controls, design features, or technical safety requirements (TSRs).
- No significant unreviewed safety question (USQ) would result from the proposed operations for intact hot cell removal.

Based on the assumptions and recommendations discussed in this section two issues were identified for further review:

> ***The draft BIO (FH 2000a) should be revised prior to approval to authorize the removal of each individual hot cell (as design features) when packaged for transport and disposal.*** *This would authorize removal as a design feature upon completion of an appropriate evaluation and confirmed by administrative review. The evaluation would document that the internal contamination in a given hot cell is below the TRU threshold and the hot cell has been isolated from facility systems and packaged for shipment in a fashion adequate to meet the onsite SARP.*
>
> ***Alternative methods for egress from the 327 Building should be evaluated.*** *This will ensure that the most effective approach is used. Although a recommendation for a temporary air lock building (see Attachment 4) was made for this review, there may be more economical options; specifically, a simple door should be considered in the east face of the 327 Building. This may be technically justified if appropriate administrative controls are imposed upon its operation.*

The safety basis documenting current and anticipated operating conditions and operations is the draft BIO (FH 2000a). Although not approved for public release or for use as an authorization basis for the 327 Building, a review of the document concluded that the systems as documented, with minor exceptions, appear to be accurate. The basic methodology and analysis appear to be sound. If the inventory postulated is correct, the Hazard Categorization as HC3 is appropriate. The Hazard Identification (Table 5-1) and Hazard Evaluation (Table 5-7) have been systematically developed, are comprehensive, cover known accident experience and credible accidents for this type of facility, and support the proposed TSRs. The proposed TSRs consist of administrative controls (organization and management, material management, criticality safety, fire protection, radiation protection, and emergency preparedness) and design features (hot cells and packaging containers). The designation of hot cells as the only installed design feature is significant; as each cell's inventory is reduced, it becomes a candidate to be removed from the TSR design factor controls.

Because it is likely that the draft BIO (FH 2000a) will be approved without significant modification, this analysis is based on a standard USQ evaluation. The USQ methodology requires comparing the proposed modifications of a facility or proposed work to be performed in the facility with the existing BIO to determine whether the change poses 1) a significant increase in event probability or event consequence with a resulting overall increase in event risk or 2) a new scenario not previously evaluated in FH (2000a).

A USQ evaluation of the approach developed in Section 4 would identify the following differences from the BIO (FH 2000a) baseline. A new confinement boundary penetration would be added to the 327 Building's east boundary, providing a new potential release path. Individual hot cells will be isolated from the heating and ventilation system, posing the potential for 1) accumulation of radiolytic hydrogen and 2) deflagration if an ignition source is present. And finally, loads of up to 200 tons will be raised to or transported at a height of up to 0.5 meter (20 inches) above the operating deck within the 327 Building, with risk to the structure due to drops resulting from either transportation accidents or natural phenomena (seismic).

Because the building confinement is not identified as a design feature, the appropriate test for this structural modification is its implementation of the administrative control for radiation protection. Provision of a temporary airlock building east of the existing structure built to Uniform Building Code (UBC) requirements, with provision of structural elements specifically designed to prevent loading of the main 327 Building structure in the event of an earthquake or other natural phenomena, combined with a door in the east face of the existing structure built to the existing facility requirements, would result in adequate confinement capability to meet the radiation protection need. Further, it may be possible to demonstrate that the temporary airlock building is not required if the facility is placed administratively in a stabile condition (i.e., no activities posing a risk of raising airborne contaminants is under way) before the door in the east face is opened.

The risk of hydrogen accumulation in a hot cell, once the cell is isolated from the heating and ventilation, can be managed by a properly engineered sequence. Reduction in the radiation field in the hot cell reduces the rate of hydrogen generation to an extremely low level; thus a LLW designation should make hydrogen accumulation virtually incredible. Further, provision of a filtered vent before isolation would allow hydrogen removal due to diffusion and atmospheric pressure fluctuations. Filling the void space in the hot cell with grout or nonflammable foam will limit the quantity of gas mixtures that can accumulate while creating a geometry that precludes the potential for any hydrogen ignition from propagating to a deflagration, much less a detonation. Application of the administrative controls for fire protection, which would provide for the above measures, would suffice to authorize hot cell isolation under FH (2000a).

The addition of a filtered vent would help to mitigate hydrogen buildup. This vent would also enable the cell to be filled with grout by allowing the evacuated air to be removed during grouting. Application of a fixative will help to prevent the spread of contamination. A fixative may be applied before moving the hot cells and may be used in conjunction with grouting the cells at a later time.

Suspending loads up to 200 tons during hot cell isolation and transport has the potential to cause damage in three ways. First, the collapse of the hot cell can release the contents of that cell and potentially one adjacent cell. The consequence of this accident is bounded by current explosion-based-accident dose commitments. Second, the cell could damage the surrounding facility. This risk can be estimated by bounding the zone at risk, which, if unconstrained, would consist of a length equivalent to the height of a hot cell plus the height of the support, or 3.5 m from the base of the hot cell during transport. Protection of the basic facility structure would be achieved by the proposed approach of moving cells on the centerline, which can be accomplished only by removing them from the east end or providing such a broad engineered base as a design factor that lateral collapse is not possible. Third, damage to the floor is acceptable with the constraint that the accident not propagate to structural collapse of the facility (threatening design features). Hence, the height to which a cell can be lifted is limited by the energy the floor can absorb from an unconstrained drop without structural failure (e.g., local collapse into the basement).

5.2 Transportation/Disposal Package

The following evaluation indicates that the hot cells may be transported intact as a "self-contained" package, with the safety basis approved and documented by existing onsite SARP. Based on the assumptions and recommendations discussed below, two issues were identified for further review:

> ***Future changes in the onsite safety program via 10 CFR 830 should be monitored to ensure that the desired packaging choice is not affected****. Recent conversations and meetings with the Fluor Hanford (FH) Packaging and Transportation Program and DOE-RL Authorization Basis Division indicate that there will be changes to the onsite program for packaging and transportation, specifically with regard to the implementation of the 10 CFR 830, Nuclear Safety Management, final rule of January 10, 2001. Order 460.1A is specified in 10 CFR 830 as an authorized method for meeting the rule requirements. At this time, it is anticipated that any desired changes in the packaging payload and/or safety basis may be approved via an USQ process.*

> ***Use of the draft BIO (FH 2000) source term, based on 15 grams of ^{239}Pu in a hot cell, may exceed existing onsite SARP coverage for a self-contained package****. Further characterization will be needed to finalize the bounding source term for packaging and shipping determinations. Further decontamination efforts and/or safety basis modifications (via an existing onsite SARP) may be required. The source term described in Table 4.1 of HNF-3435 (Landsman et al. 1998) falls well within the current source term limits for existing onsite SARPs for a self-contained package. However, the Table 4.1 data are presented as an average activity rather than as a maximum. Also there are unknowns such as residual contamination in hidden locations and possible activation of components. Further characterization will be needed to confirm the source term (see discussion in Section 4.1).*

The critical parameter for any radioactive material packaging decision is the source term, which requires the specification and maximum quantities of each radioactive isotope and any other hazardous material. From the source term information, a general packaging type can be specified from 49 CFR 173 Subpart I, Class 7 "(Radioactive) Materials Regulations." The source term is used in any required safety basis analysis documentation (e.g., SARP) to show that the technical requirements for containment, shielding, and subcriticality are met. Additional information and scoping calculations to determine the proper packaging classification(s) for the 327 Building hot cells are provided in Attachment 7.

As noted in the conclusions of the Attachment 7 evaluations, even a relatively low-end packaging (such as a metal box) to meet DOT requirements would require a significant amount of work and expense. Construction of a box around the hot cell would likely need to be performed on the transporter and would not offer much technical benefit because the hot cell will be sealed and decontaminated already. Therefore, it is recommended that the transport "packaging" be the hot cell itself, and the transportation be performed under the onsite packaging and transportation program that is allowed under DOE Order 460.1A, *Packaging and Transportation Safety*, and further specified in HNF-PRO-154, *Responsibilities and Procedures for All Hazardous Material Shipments* (Fritz 2000a).

The packaging will primarily consist of the hot cell "intact," with residual internal radioactive contamination. A breather filter will be installed in the cell wall and fixative applied to the contaminated interior surfaces. In addition, the hot cell may be filled with grout to meet disposal requirements. As described in Section 4.3, hot cell package integrity will be established by the use of an integral frame, pallet, and strongback system to enclose the hot cell, ensure that it will not fall apart during normal transport conditions, and provide secure attachment points for an engineered transport tiedown system. All exterior surfaces will be decontaminated to the limits specified by the applicable authorization document (discussed below), and reinforced plastic will be wrapped around the hot cell prior to transport.

Transport of the hot cell will require closure of the roadway from the 300 Area to the Wye barricade. This is a routine and proceduralized operation that has been used for many years on the Hanford site for packages that are approved by an onsite SARP. From HNF-PRO-157 (Fritz 2000b): "All radioactive materials transported over onsite roadways that are open to the public (DOT definition of "in commerce") must be in compliance with DOT regulations. All shipments south of the Wye Barricade are considered "in commerce" and subject to DOT jurisdiction. This applies to both public access roadways and rail crossings with which they come in contact. If the shipment does not meet these regulations, transporting on the Hanford Site may be done during off-peak hours with the roads closed and/or crossings manned by Benton County Sheriff or Hanford Patrol to prevent public access to the shipment."

Precedent for this type of shipment has been established at Hanford. Two onsite SARPs are in place as an authorization basis:

- HNF-3341, Revision 0, Safety Analysis Report for Packaging (Onsite) Decontaminated Equipment Self-Container (Boehnke 1998)
- HNF-SD-TP-SARP-007, Revision 1, Safety Analysis Report for Packaging (Onsite) Flexible Material Packaging. (Boles 2000)

Preliminary evaluation of the F, G, and SERF cell source terms (Landsman et al. 1998, Table 4-1) indicates that the proposed hot cell packaging will meet the radiological limits specified by both of these onsite SARPs. Boehnke (1998) allows up to $100A_2$ units, which the specified payloads clearly meet. Boles (2000) uses a "sum of the fractions" calculation methodology similar to that used to calculate an A_2. Scoping calculations indicate that the F, G, and SERF cell source terms specified in Landsman et al. (1998, Table 4-1) will meet the radiological limits specified in Boles (2000) by factors of 23, 19, and 10, respectively. Other physical (tiedowns, specific plastic wraps, etc.) and radiological (dose rate from package) limits are also specified in the SARPs, but preliminary evaluation indicates that the hot cell packages can be configured to meet those requirements. In the worst case, a revision to a SARP may be performed to clarify or evaluate any special technical areas that the proposed hot cell transport may present.

It is important to note, however, that alpha levels higher than used in Attachment 7 may exceed the current SARP source term limits. For example, the source term specification from the draft BIO (FH 2000a), states that the plutonium holdup in each hot cell may be up to 15 grams. Using the ratio of isotopes shown in the Attachment 7.4 evaluation (based on 15 grams of ^{239}Pu), calculations show that neither of the previously mentioned onsite SARP source term limits can be met for this quantity of material. Note in this case it may be necessary to decontaminate the cells to meet the SARP limits even if the cells are designated LLW. This is indicative of a need for additional source term characterization and/or decontamination of the hot cells, and a possible need to perform additional safety basis analyses (via Engineering Change Notice and/or USQ process) related to the onsite SARP. Realistically, it is likely that the actual source term will lie somewhere between the BIO and Table 4-1 of Landsman et al. (1998), but source term characterization remains an issue to be resolved.

A second issue is related to future changes in the onsite safety program. Recent conversations and meetings with the Fluor Hanford Packaging and Transportation Program and DOE-RL Authorization Basis Division indicate that there will be upcoming changes to the onsite program for packaging and transportation, specifically with regard to the implementation of the 10 CFR 830, Nuclear Safety Management final rule, of January 10, 2001. This rule will require the implementation of a site-wide "Transportation SAR" (Safety Analysis Review) as specified in DOE Order DOE-O-460.1A, *Packaging and Transportation Safety*. Order 460.1A is specified in 10 CFR 830 as the "safe haven" method for meeting the rule requirements.

DOE-RL has been funded to prepare the transportation SAR and is in discussions with FH on how to project-manage and contract this effort in conjunction with upgrading the site packaging and transportation operations with the main Hanford contractors (FH, PNNL, Bechtel Hanford Inc., and CH2M-HILL).

In the interim, DOE-RL has stated that Fluor Hanford, Inc. should maintain business as usual, and that existing onsite SARPs will be grandfathered into the new Transportation SAR. When the new SAR is in place, a USQ process will be used whenever a new payload or packaging type is needed. The current plan is for the new Transportation SAR to be developed and implemented within this calendar year.

Other activities related to the above actions are upcoming revisions to HNF-PRO-154, *Responsibilities and Procedures for All Hazardous Material Shipments* (Fritz 2000a), to implement the new process. As part of the new Transportation SAR, activities are already underway to define prescriptive packaging standards (anecdotally called "minimum packaging standards") that will use 10 CFR 71, *Packaging and Transportation of Radioactive Material*, performance standards as a starting point and will allow lower levels of packaging performance in conjunction with other performance, administrative, and risk analysis measures. Because the hot cell payloads should not approach a Type B quantity following decontamination, demonstration of 10 CFR 71 packaging performance is not a concern; however, the USQ process (when developed) may need to be exercised to authorize this packaging and transportation campaign.

Based on the above evaluation, no insurmountable issues or concerns have been identified for the onsite transportation of the 327 Building hot cells as intact packages. Based strictly on the current knowledge of the radiological content, the hot cells will not need to be qualified to meet hypothetical accident conditions. An appropriately designed framing system may be used to enclose and secure the hot cell components to withstand handling and transportation conditions. Contamination will be fixed, and openings on the hot cells will be closed off.

It is not anticipated that the safety basis authorization for the onsite transportation of the hot cells will be an issue. Precedent for similar onsite packaging has been demonstrated by existing onsite SARPs for "self contained" equipment, and it is not anticipated that future program development would prohibit such shipments, especially as the cleanup of the Hanford Site moves toward a decontamination and decommissioning (D&D) mode. Qualitatively, it is clear that the dose consequence to workers dismantling and packaging individual components of the hot cells will be much greater than the dose consequence of any postulated transportation accident with a one-piece hot cell.

6.0 SERF RECOMMENDATIONS

6.1 SERF Cell Decommissioning

Because the upper portion of the SERF cell is similar to A cell (see Table 6.1), it is recommended that it could be removed and disposed of using the same basic concept described in Section 4.0 of this report.

Table 6.1. A Cell and SERF Cell Feature Comparison

Feature	A Cell	SERF
Size - inside dimensions	9.5x4.5x8 ft	12x5x5 ft
Wall thickness	18 in.	15-18 in.
Empty weight (estimate)	155 tons	160 tons
Construction	Meehanite Cast iron blocks	Laminated armor plate
Cell Mounting	Flush with floor. Anchor bolts into floor	On 2-ft raised concrete pedestal. Anchor TBD

Existing characterization data show that it could be disposed of as LLW. This is not expected to cause any significant packaging or removal problems. The basic steps in this process would be as follows:

- Isolate the ventilation and transfer tube penetrations. The ventilation penetrations could be isolated by cutting and blanking them from the outside, and the transfer tube could be isolated by filling it with foam (access from either inside the cell or from below) and then cutting the cell support foundation as described below.
- Prepare the cell for lifting by installing a lift package in a manner similar to that described for cells A–I in Section 4.3. Some differences in details would be required to adapt to the construction differences between the two types of cells.
- Sever the connection between the cell and the concrete pedestal using a concrete wire saw (e.g., Pro Cut--Kennewick, WA). This first cut would be made just below the cell bottom plate. To position the internal transporter under the cell, the concrete pedestal would first be removed by jacking the cell off the foundation, making a second cut at or near floor level with the concrete wire saw, and then moving the pedestal out from under the cell.

At this point, the cell would be ready to be put on the transporter and moved to the east end of the building for removal. A method of negotiating the required 90° turn will be required. Options include turning capabilities built into the transporter, a temporary turntable, or winching using thick Teflon plates. The remainder of the operation would proceed from here as for cells A through I.

6.2 Nitrogen (N_2) Recirculation and Cooling System

The end points for the 327 Building (Lemarr 1998) have been issued and incorporated into the baseline deactivation plan for the facility. The nitrogen recirculation and cooling system for the SERF cell was not specifically addressed in the end point specification. This system along with other piping and mechanical systems in the 327 Building basement were lumped together in the generic category Basement Equipment and Mechanical rooms. This category falls under Case 1, Task Type 4, which is governed by compliance with regulations and requirements that drive the removal and disposal of waste for areas where routine access is required. In this case, the basement is considered a routine access space. The end point is very generic and is oriented toward removal of unattached equipment and isolating the remainder. In this case, the baseline assumes most of the N_2 recirculation and cooling system would be removed for disposal during deactivation.

The end point (Case 6—abandoned in place) for the SERF cell and SERF storage cell as well as the other hot cells is the same and includes the following:

- Remove/fix/contain removable radioactive contamination in cell to meet radiological requirements
- Remove accumulated radioactive, dangerous and mixed wastes
- Drain/vacate contents and isolate cell utility feeders
- Remove minor equipment containing hazardous substances
- Isolate/seal cell access ports to inhibit contamination migration
- Remove manipulator arm seal ports to inhibit contamination migration
- Isolate/seal cell drains to inhibit contamination migration and localize water intrusion
- Label cell face statusing all systems within are abandoned in place
- Turnover package items—deactivation work plans/packages

The hot cell end point allows the cells and equipment to be abandoned in place once the above end point criteria have been met. This strategy assumes that the cells will be handled by the D&D team at a future date after deactivation is complete. The end point is clearly established and measurable, easy to accomplish, and less expensive than waste disposal. In summary, the endpoint is to remove contamination to radiological levels, fix or contain what is left and meet applicable waste regulations and requirements. This clearly supports the facility goal to leave the facility in a safe and stable condition that supports D&D work at a future date. However, it leaves the hot cells and isolated equipment to be removed and disposed in the near future during the 300 area accelerated closure project. That end point goal is being re-evaluated and a new one might be established to support disposal of the cells and N_2 recirculation and cooling system. It is more cost-effective to handle isolating the cells, fixing contamination, and removing the cells for disposal in one task rather than two separate tasks separated by less than 10 years.

The BIO (FH 2000a) states that the SERF cell piping and ducts have 8.72 grams of plutonium as a holdup inventory. The characterization report (Haggard and Brackenbush 1995) from the 1995 survey data also documents dose rates between 10-110 mrem/hour. These data were obtained when the facility still had a large inventory of contaminated materials in the hot cells to be disposed. Recent survey data were not available for this review. During the team's facility tour, this area of the facility was not available for viewing due to the dose and lead shielding in the area. Currently only 30 metal cans from an inventory of 156 remain to be disposed from the hot cells. New/current survey and characterization data should be obtained after the facility de-inventory is complete.

Options to dispose of the N_2 recirculation and cooling system equipment and piping would likely include both low-level and TRU waste. Conservatively assuming that the 8.72-gram plutonium holdup is ^{239}Pu, the waste weight would need to exceed 13,000 lb for a waste package to be designated as LLW.

$$(8.72 \text{ g Pu} * 0.0692 \text{ Ci/g}) / 100 \text{ nCi/g} * 1000000000 \text{ nCi/Ci} = 6{,}034{,}000 \text{ g or} \sim 13{,}000 \text{ lb}$$

It might be possible to dispose of the system piping components and equipment in an aggregate form and achieve a LLW designation. However, due to the quantity of plutonium and weight of the waste, it is likely some of the components or some pieces will designate as TRU waste. The process for packaging large TRU waste components in compliant waste containers for disposal at WIPP is still being developed. Right now the standard waste box is the only approved method for packaging bulk items. The Ten Drum Overpack, approved as an overpack container for ten 55-gallon drums, is being evaluated for direct packaging of large bulk items.

7.0 CONCLUSIONS

A list of issues identified during this review is provided in Table 7.1 with proposed actions for closure. These were taken from the text of the report sections indicated in the third column of the table. The first four issues listed are associated with the critical need to verify that cells can be disposed as non-TRU waste. In discussion on inventory certification (Section 4.2), reference was made to potential technology that could be adapted to support characterization using neutron or gamma detectors. Adaptation of this technology to this application may offer an effective means to resolve these four issues and provide the needed verification of the waste characterization for disposal. It is recommended that this be assessed for follow-on action.

Table 7.1. Summary of Issues

Issue	Proposed action for closure	Report Section Number
The quantity of radionuclides entrained in the painted layers on the interior surface of the hot cell walls is unknown.	Resolution of this issue will require additional sampling and analysis. A sample/analysis plan will be required to obtain a representative sample of the paint and perform radiochemical analysis to determine the radionuclide content. Alternatively, a nondestructive assay technique might be applied from the interior of the cell in situations where the background radiation is low.	4.1
Activation products or contamination entrained in the steel walls is not quantified.	Resolution of this issue will involve verifying that steel walls do not contain activity levels that would preclude onsite disposal. In a conversation with Cecil Boyd, it was confirmed that the cell interiors were painted prior to hot operations. This supports the assumption that the steel walls should not have entrained radionuclides.[a]	4.1
Radionuclide and chemical characterization of the void space between the hot cell floor and the facility floor is unknown.	Resolution of this issue will require additional sampling and analysis. A sample/analysis plan (see above) will be required to obtain representative sample from this area and qualify the radionuclide and chemical inventory.	4.1
Physical characteristics of the hot cells need to be inspected to confirm as-built cell and facility interface configurations.	This is necessary to establish a technical basis for isolation and intact removal. This should be addressed when the characterization plan is developed (as discussed in Section 4.1).	4.3

(a) Personal communication with Cecil Boyd, retired Hanford employee who was responsible for many of the drawings that were used for this review. January 31, 2001.

Issue	Proposed action for closure	Report Section Number
The draft BIO (FH 2000a) should be revised prior to approval to authorize the removal of each individual hot cell (as design features) when packaged for transport and disposal	This would authorize removal as a design feature upon completion of an appropriate evaluation and confirmed by administrative review. The evaluation would document that the internal contamination in a given hot cell is below the TRU threshold and the hot cell has been isolated from facility systems and packaged for shipment in a fashion adequate to meet the onsite SARP.	5.1
Alternative methods for egress from the 327 Building should be evaluated.	This will ensure that the most effective approach is used. Although a recommendation for a temporary air lock building (see Attachment 4) was made for this review, there may be more economical options; specifically, a simple door should be considered in the east face of the 327 Building. This may be technically justified if appropriate administrative controls are imposed on its operation.	5.1
Future changes in the onsite safety program via 10 CFR 830 should be monitored to ensure that the desired packaging choice is not affected.	Recent conversations and meetings with the Fluor Hanford Packaging and Transportation Program and DOE-RL Authorization Basis Division indicate that there will be upcoming changes to the onsite program for packaging and transportation, specifically with regard to the implementation of the 10 CFR 830, Nuclear Safety Management final rule, of January 10, 2001. Order 460.1A is specified in 10 CFR 830 as an authorized method for meeting the rule requirements. At this time, it is anticipated that any desired changes in the packaging payload and/or safety basis may be approved via a USQ process.	5.2
Use of the draft BIO (FH 2000a) source term, based on 15 grams of ^{239}Pu in a hot cell, may exceed existing onsite SARP coverage for a self-contained package.	Further characterization will be needed to finalize the bounding source term for packaging and shipping determinations. Further decontamination efforts and/or safety basis modifications (via an existing onsite SARP) may be required. The source term described in Table 4-1 of Landsman et al. (1998) falls well within the current source term limits for existing onsite SARPs for a self-contained package. However, the Table 4.1 data are presented as an average activity rather than as a maximum. Also there are unknowns such as residual contamination in hidden locations and possible activation of components. Further characterization will be needed to confirm the source term (see discussion in Section 4.1).	5.2

8.0 REFERENCES

10 CFR 830. January 10, 2001. *Nuclear Safety Management*, Final Rule. U.S. Department of Energy.

10 CFR 71. 1997. *Packaging and Transportation of Radioactive Material.* U.S. Nuclear Regulatory Commission.

40 CFR 268. November 7, 1986. *Land Disposal Restrictions.* U.S. Environmental Protection Agency.

49 CFR 173 Subpart I, Class 7 (Radioactive) Materials. U.S. Department of Transportation.

Bechtel Hanford. June 18, 1998. *Environmental Restoration Disposal Facility Waste Acceptance Criteria.* BHI-00139 Rev. 3, Bechtel Hanford Company, Richland, Washington.

Boehnke WM. 1998. *Safety Analysis Report for Packaging (Onsite) Decontaminated Equipment Self-Container*. HNF-3341 Rev. 0, Waste Management Federal Services, Richland, Washington.

Boles JL. 2000. *Safety Analysis Report for Packaging (Onsite) Flexible Material Packaging*. HNF-SD-TP-SARP-007 Rev. 1, Waste Management Federal Services, Richland, Washington.

DOE Order 460.1A. October 2, 1996. "Packaging and Transportation Safety." U.S. Department of Energy.

DOE Order 435.1. July 9, 1999. "Radioactive Waste Management." U.S. Department of Energy.

DOE M 435.1-1. July 9, 1999. "Radioactive Waste Management Manual." Chapter 3, "Transuranic Waste Requirements." U.S. Department of Energy.

DOE. November 8, 1999. *Waste Acceptance Criteria for the Waste Isolation Pilot Plant.* DOE/WIPP-069, U.S. Department of Energy.

Fluor Hanford. 2000a. *327 Building Basis for Interim Operation* (Draft). HNF-4667, Fluor Hanford Company, Richland, Washington.

Fluor Hanford Co. August 2000b. *Hanford Site Solid Waste Acceptance Criteria.* HNF-EP-0063 Rev. 6 (draft). Fluor Hanford Company, Richland, Washington.

Fritz DW. October 30, 2000a. "Responsibilities and Procedures for All Hazardous Material Shipments." HNF-PRO-154 Rev. 2, Fluor Hanford Co., Richland, Washington.

Fritz DW. October 30, 2000b. "Radioactive Material/Waste Shipments." HNF-PRO-157 Rev 2, Fluor Hanford Co., Richland, Washington.

Gold R, CL Mohr, and AD Wi. 2000. "Limitations in NDA Systems for Nuclear Criticality Safety." *Proceedings of NDA Conference 2000.*

Haggard DL and LW Brackenbush. 1995. *Determination of the Radioactive Material and Plutonium Holdup in Ducts and Piping in the 327 Building.* PNL-10787, Pacific Northwest National Laboratory, Richland, Washington.

Johnson WL. May 25, 2000. *324/327Buildings Stabilization/Deactivation Project Management Plan.* HNF-IP-1289 Rev. 3, Fluor Hanford Co., Richland, Washington.

Kosiancic EJ. August 2000. "Technical Review: 327 Building Stabilization and Deactivation." Fluor Hanford Co., Richland, Washington.

Landsman SD, RL Hill, and RM Millikin. 1998. 327 *Building Physical and Radiological Characterization Study.* HNF-3435 Rev. 0, B&W Hanford Co., Richland, Washington.

Lemarr JM. September 24, 1998. “327 Building End Point Specification.” HNF-2118 Rev. A, Fluor Hanford Co., Richland, Washington.

ATTACHMENT 1 - STATEMENT OF WORK: TECHNICAL REVIEW OF OPTIONS FOR 327 BUILDING HOT CELL STABILIZATION AND REMOVAL

Purpose

The purpose of this review is to provide insight to the technical challenges presented by the contaminated hot cells and the nitrogen recirculation system in the 327 Building and to define work needed to select and implement a specific technical path to stabilize and deactivate the facility.

Background

In 1996, the 327 Building was transferred from PNNL to Fluor Hanford to begin the transition from operations to stabilization and deactivation. The 324/327 Building Stabilization/Deactivation Project Management Plan (Johnson 2000) describes how these buildings will be transitioned to a safe and stable condition that requires minimal surveillance and maintenance. The most significant challenge to stabilizing and deactivating the 327 Building is the deactivation of the hot cells. Ten of these cells are unique, and their unusual designs present challenges to conventional deactivation methods, as well as opportunities for creative new approaches. The SERF cell presents special challenges because it is constructed of both steel and concrete, extends to the basement, and is highly contaminated. The SERF cell is maintained in an inert nitrogen atmosphere by a connected nitrogen recirculation system, and this equipment must also be stabilized and deactivated.

This review is an extension of one conducted in FY 2000 that addressed the plans and strategy for deactivation of the 327 Building. That review recommended a feasibility study be performed in early FY 2001 to determine the preferred method for cell deactivation and specifically recommended an evaluation of intact cell removal options. The SERF cell and its associated nitrogen system are included in the scope of this review as these facilities represent significant uncertainty in the stabilization path forward.

Technical Review Scope and Objectives

The Project Management Plan addresses activities needed to deactivate the 327 Building at a summary level. Scope includes the acquisition of waste removal, handling, and treatment technology. This Technical Review will focus on certain aspects of the intact cell removal and deactivation alternative that promise a significant reduction in schedule and cost for completing the 300 Area restoration. Intact cell removal, shipment, and disposal with little or no decontamination have just recently been considered as an option for facility deactivation.

The objectives of the Technical Review are to identify and explore key questions that must be resolved prior to abandoning the baseline in favor of intact cell disposal. At least three key issues must be addressed: 1) regulatory requirements, 2) compliance demonstration, and 3) removal techniques. A line of inquiry as described by the following categories and questions should be considered a starting point:

1. Evaluate the technical implications of relevant laws and regulations.
   - What are the DOE regulations that apply to onsite disposal? What are the limits that must be met by the "package" that is to be shipped and disposed of (dose at contact, containment, dimensions, weight, TRU content, etc.)? What measures are available to ensure compliance?
   - What are the applicable DOT and DOE requirements governing transportation from the 300 Area to the disposal site? What measures will be required to comply with transportation regulations?

- What EPA or Washington State laws and regulations may be applicable to the removal, transportation, and disposal? What measures will be required to ensure compliance with governmental laws and regulations?
- Do DOE, State, or EPA regulations for TRU waste disposal or mixed TRU waste disposal drive actions that could be safely obviated at significant savings?

2. Identify knowledge or technical capability needed to prepare, package, remove, ship, and dispose of an intact hot cell.
   - What activities/processes must be performed to produce a package that meets the requirements identified above?
   - What technologies are available to perform those activities? What are the risks or limitations of these technologies?
   - Can cost or risk be substantially reduced through a fundamental advancement in knowledge (such as characterization of cell contamination, effectiveness of alternative technologies, such as fixatives or decon methods, etc)?

3. What are the most important tasks that should be completed before the approach for cell deactivation is selected?

4. Review the technical basis and approach for stabilizing and deactivating the SERF Cell and the associated nitrogen recirculation system:
   - Is the endpoint for decontamination clearly established and measurable?
   - Is the current knowledge of contamination sufficient to select a sound technical approach?
   - What are risks of the baseline approach, and can they be overcome with reasonable measures?

5. Identify knowledge or technical capability needed to improve the technical approach:
   - Are there any relevant new or emerging technologies or methodologies that can offer significant advantages?
   - Can cost or risk be substantially reduced through a fundamental advancement in knowledge (such as characterization of contamination, or effectiveness of alternative technologies, such as fixatives or decon methods, etc)?
   - Are new technologies or capabilities needed to implement alternative strategies? Identify these and the risk associated with development or acquisition.

Conduct of the Review

Both the review team and project personnel recognize that this review must be conducted efficiently and effectively to support a decision that must be made before FY 2002 begins. The review team agrees to read and understand the review materials before the working sessions to minimize the time required of project staff. Similarly, the project agrees to accommodate review team requests for documentation or additional explanation.

Schedule

This review is expected to be conducted starting in January 2001 and will be completed by March 2001. As project schedules are refined, the review schedule may change.

Review Costs

Technology Management will be responsible for planning and coordinating review, including identification of reviewers, arranging and scheduling meetings, contracting for external reviewers, and issuance of the review report. Technology management will provide financial resources needed for the external reviewers.

The project will provide appropriate technical staff for opening briefings and for follow-on discussions with the review team. A compendium of relevant technical information will be provided to the review team by the project at least a week ahead of the beginning of the review.

Deliverables

1. Closeout meeting. The review team will present a graded set of recommendations to project staff. This forum will provide an opportunity to understand and potentially modify conclusions and recommendations.

2. Project response. Either during or following the closeout meeting, the project will provide a graded response to the recommendations, indicating intended actions (including "no action"). The project response will be provided within two weeks.

3. Review report. A final report summarizing conclusions and recommendations will be submitted to the project within one month of the conclusion of the review.

Agreed:

________________________________	________________________________
River Corridor Project	Technology Management

ATTACHMENT 2 - BIOGRAPHICAL SKETCHES OF REVIEW TEAM MEMBERS

Donald E. Ball

Don Ball is a consulting engineer with Vista Engineering Technologies, LLC. He has over 30 years of design and management experience in nuclear processing facilities and power plant design and construction with General Electric, Rockwell International, and Westinghouse Corporation. He has led development programs and managed engineering teams responsible for remote mechanical systems and components for radioactive solid waste and chemical processing facilities. He has held technical management positions on several large project design teams that perform remote mechanical equipment development and design. Mr. Ball has also served as the project manager on process system and equipment designs for various chemical and waste processing facilities and project engineer for nuclear power plant design and construction. He has a B.S. in mechanical engineering from California Polytechnic College, San Luis Obispo.

Paul T. Day

Paul. Day is a senior project manager at Holmes and Narver/DMJM. He has 30 years of experience in environmental protection, hazardous waste management and cleanup, and regulatory interface. Working for the EPA, he led the effort to stop all untreated liquid effluent discharges to the soil at Hanford. He was involved in planning and forming the Hanford Advisory Board, a citizen advisory group. He provided technical support to DOE-RL in environmental restoration, waste management, technology development, program planning and management, policy and permits, compliance, laboratory management, data quality objectives, risk assessment, and technology development application. Mr. Day has served as project manager for MACTEC and HND and provides technical support for the Spent Nuclear Fuels project. He has a B.S. in bacteriology and public health and a master's degree in public health (M.P.H.).

Bruce D. Groth

Bruce Groth is a senior engineer at ARES Corporation. He conducts engineering studies and prepares conceptual design reports, estimates, and detailed designs for Hanford projects such as the Fuel Removal System of the Spent Nuclear Fuels project. He designed instrumentation to detect, monitor, and mitigate water accumulation in a flammable gas control system; prepared a decontamination options study for the 222-S Laboratory; and written conceptual design reports for upgrades to instrumentation, control systems, decontamination approaches, and removal and environmental requirements for underground radioactive storage tanks. Mr. Groth provides all ARES offices with failure modes and effects analysis and reliability and maintainability activities. Responsibilities include Safety Analysis Reports, baseline criteria, D&D plans, risk management, cost and schedule control, and NEPA documentation; systems engineering; and providing design oversight. He has B.S. degrees in chemistry and mathematics from Willamette University.

William G. Jasen

Bill Jasen is a senior project manager at Project Enhancement Corporation. He has 22 years of technical and project management experience, starting with the Clinch River Breeder Reactor and continuing with several project management positions at Hanford. He has significant experience in waste management, deactivation planning, D&D, and chemical processing. Mr. Jasen works on certification to ship TRU waste to the WIPP; performs characterization and certification of TRU waste using radiography, radioassay, visual examination, and headspace gas sampling and analysis; and performs readiness review/startups on the WRAP, CWC, and Uranium Oxide facilities. His education and experience with DOE and its contractors led to his certification as a Project Management Professional. He has a B.S. in nuclear engineering from the University of California at Santa Barbara and an M.S. in engineering management from Washington State University.

Marlin R. Lindquist
Marlin Lindquist is senior consulting engineer at M&D Professional Services, Inc. He has over 40 years of experience in managing multidiscipline engineering and project teams. He has worked in the nuclear industry in engineering design, analysis, construction, testing, and project maintenance, most of it with Westinghouse Hanford Company and Boeing. He was engineering manager of the facility stress analysis group and senior consulting engineer for major structural analysis projects at Hanford, including the Spent Nuclear Fuels project and the Chornobyl Shelter Implementation project. His work in seismic qualification and structural analysis has been integral at Hanford as well as Savannah River. He has a B.S. and an M.S. in civil engineering from the University of Minnesota and is a licensed professional engineer in the state of Washington.

Richard J. Smith
Richard Smith is project engineer for Packaging Technology, Inc. He has over 16 years of experience in regulatory and engineering evaluation of radioactive material packaging and transportation systems and preparation of Safety Analysis Reports for Packaging (SARP) at several major contractors on the Hanford Site. His technical competencies include program and project management, NRC/DOE package licensing, ASME pressure vessel code evaluation, structural and heat transfer analysis, onsite safety analysis, procurement, and fabrication. Other work experience at Hanford includes package testing, international procurement of the LR-56 liquid transporter for three DOE sites, project management of the MCO Cask SARP, and program management of classified weapons packaging reviews for DOE-Albuquerque. He has a B.S. in mechanical engineering from Gonzaga University and is a licensed professional engineer in the state of Washington.

James D. Thomson
Jim Thomson is project manager for XWEST Group, Inc. He has nearly 30 years of experience in plant operations, technical support, and facility restoration. He is an expert in engineering process implementation, performance assessment, requirements management, technical and safety baseline development and implementation, and equipment design and development. He is a technical management professional with a background in nuclear, electronics, and waste management at companies such as Westinghouse Hanford, Fluor Daniel Hanford, and Holmes and Narver/DMJM . He managed the technology selection decision process for retrieval of waste from the Hanford waste tanks and developed the Spend Nuclear Fuels Project response to critical DNSFB and corrective action management issues. He has a B.S. in aerospace engineering from Iowa State University, an M.S. in mechanical engineering from the University of Pittsburgh, and is a licensed professional engineer in the state of Washington.

James C. Wiborg
Jim Wiborg leads the transition of the Core Conversion Project to fossil fuel alternatives for the DOE International Nuclear Safety and Cooperation and DOD Defense Threat Reduction Agency at PNNL. He has held safety-related engineering and management positions in U.S. reactors and facilities for over 30 years. He served as senior nuclear safety manager at Westinghouse Hanford Company, where he was responsible for nuclear policy and oversight of all Hanford reactors and nuclear facilities and was chairman of the national Westinghouse Nuclear Facility Safety Committee. He has led engineering and safety analysis activities at fuel fabrication facilities, spent fuel storage facilities, and post-irradiation test laboratories. At PNNL he performs program development in nuclear safety and national security activities for the Soviet-Designed Reactor Safety Program, Chornobyl Shelter, and Ukrainian Nuclear Fuel Technology Transfer project. Jim has B.S. degrees in mathematics and physics and M.S. in physics (nuclear emphasis). He has taken and taught nuclear engineering courses at the U.S. Naval Nuclear Power School.

ATTACHMENT 3 - 327 BUILDING REVIEW CELL DRAWINGS/OBSERVATIONS

A Cell Floor Mount
H-3-8769 Sample Conveyor Assembly
Note penetration through floor into wet storage.

H-3-8717 Bldg Arrangement Cell Location
Reference drawing list

H-3-8718 Equipment Arrangement

H-3-8719 Cell Assembly

H-3-8720-23 Cell Details

H-3-5952 Floor Reinforcement for Cask Car

H-3-8770 Structural Cell Support Details

B Cell Pedestal Mount
H-4-50158 Door and Door Support for 15" Wall

H-4-50155 Details of Bottom, Top, Door and Door Support
Location of floor anchor bolts. Anchor bolt hole 1 5/8-in.-diameter smooth bore

H-4-50154 High Level Cell Assemble
Exterior wall plates defined

H-4-50156 Details of Side Plates

C Cell Pedestal Mount
H-3-8621 C-Cell Addition Assembly
- Pedestal mount shown
- Parts list with drawing numbers

H-3-8622 C-Cell Addition Details
- Wall/bottom plates detailed
- Pedestal detailed

H-3-8623 C-Cell Addition Details

H-4-50145 Intermediate Level Cell Assembly (also D&E Cells?)

H-4-50149 Door and Door Support for 10 ½" Wall

H Cell High-Temperature Tensile Test Cell--Floor Mount

H-3-13040 Building Modification and Cell Foundation
Reference drawing list

H-3-13042 Key Wedge Assembly

H-3-13291, Sheets 1 and 2 Architectural Wall Details

H-3-13295 Modification of Existing Structural Steel—Rail Beam and Rigid Frames

H-3-13020 Equipment Arrangement

- Penetration of cell/canyon floor for mounting of tensile (?) test machine
- Drain to crib waste appears to be sleeved straight through canyon floor
- Drawing list

H-3-13039 Miscellaneous Cell Details

H-3-19547 Base Casting
Appears to show penetration in base for tensile test machine

I Cell Pedestal Mount

H-3-19560 Sheet 1 and 2 Arrangement
Drawing List

H-3-19634 South Wall Casting

H-3-19635 East Wall Casting

H-3-19637 West Wall Casting

H-3-19639 Exhaust Duct Assembly and Details
Straight penetration through canyon floor. Duct grouted in

SERF Cell

H-3-22443 Architectural Floor Plans and Drawing Index
Drawing Index

H-3-22436 Sheets 1-8 Sample Preparation Cell Assembly

- Size 15x8x8 ft (h)
- Walls fabricated from laminated armor plate of varying thickness (no logic, apparent-government excess)
- Ends and front approx 18 in. thick. Ceiling approx 15 in. thick. Floor plate approx 4½ in. thick
- Mounted on 24-in. high raised concrete foundation
- Only apparent floor penetration is for transfer tube to storage cell
- Walls single piece construction. Assume bolted together but not shown here
- Drawing list

H-3-22439 Sample Cell Details

- Size 59x70x?? in. (h)
- Front face approx 15 in. thick. Assume steel, several segments make up. How fastened together?
- Sides and back steel plate cell liner
- Lead brick shielding on back. Some as wings off front ends. No indication of high density concrete?
- Drawing list

H-3-22516 Sample Prep Cell Assemble Laminated Construction
Laminate plates—"tack weld outside seams, caulk progressively any voids around window and plug liners with lead wool. Plates may be flame cut. All seal welds to be gas tight"

H-3-22517 Sample Storage Cell Laminated Construction

H-3-22518 Plug and Window Liners For Laminated Construction

H-3-22446 Structural Storage Cell Plans and Details
Lead bricks on back and front wings surrounded by concrete (no indication it's high density

H-3-22445 Floor Reinforcement and Track for Cask Car

H-3-44108 Vacuum Evaporator Cell Assembly and Details
Lead brick shielding—doesn't appear to be encased

H-3-22436 Sample Preparation Cell Assembly
Drawing List

H-3-22444 Crane Rail Reinforcement and Nitrogen System Storage Tank Concrete Base

H-3-22437 Lead Glass Viewing Window Assemblies

H-3-22438 Transfer Air Lock Assembly

H-3-22519 Sample Preparation Cell Liner Laminated Construction

H-3-22483 Metallograph Cubicle Assembly

SERF Recirculation and Cooling System
H-3-32116 SERF Recirculation and Cooling System Modification

H-3-22455 Environmental Cell and Equipment Plans and Details

H-3-32132 Shielded Filter Enclosure

H-3-32133 Filter enclosure

H-3-32134 Cooling Coil Enclosure

327 Building Civil

H-4-50207 Foundation Plan Wall and Column Footing and Details

H-4-50208 Floor Slab Details-N/S Wings

H-4-50209 Canyon Basement Special Wall Elevations and Details

H-4-50210-12 South Wing-Concrete Details

H-4-50213 North Entry-Concrete Details

H-4-50214 Canyon-West End Details

H-4-50215 Canyon-Concrete Details Floor Slab, Walls and Columns

ATTACHMENT 4 - FACILITY MODIFICATION

Facility Modification

This section identifies the requirements that would be imposed on the building to support intact hot cell removal. It also identifies facility modification options to support intact hot cell removal and discusses an approach judged to meet the various constraints most effectively.

Functions and Requirements

The existing Post-Irradiation Testing Laboratory Facility performance functions and requirements should be maintained where possible. Structural integrity of the main facility should not be degraded by modifications made for cell removal. For this technical review, it was assumed that confinement boundary capability should be maintained throughout the modifications and operations for intact hot cell removal.

Once each hot cell package is prepared for transport, an effective means for egress from the 327 Building must be selected. This must provide capability for lifting an intact hot cell package load of up to 210 tons (from the in-facility transporter and onto an over-the-road transport vehicle). It must also provide continued facility contamination confinement when the inner door is open by serving as a temporary extension of the current 327 Building confinement boundary.

Facility Modification Options for Intact Hot Cell Removal

Four options were considered for egress of the hot cell package from the 327 Building: 1) removal of the hot cell package by crane through the Post-Irradiation Testing Laboratory roof hole, 2) removal of the hot cell package through the existing west end Post-Irradiation Testing Laboratory airlock, 3) removal of the hot cell package through new door in the east end of the Post-Irradiation Testing Laboratory and 4) removal of hot cell package through new Temporary Airlock Building located on the east end of the facility.

Removal of hot cell package by crane through Post-Irradiation Testing Laboratory roof hole was not recommended because it provides high potential accident energy levels as a result of raising loads of over 200 tons for heights in excess of 10 meters. Further, it would require breaching the existing 327 Building confinement boundary in a fashion that makes temporary alternative boundaries difficult.

Removal of the hot cell package through the existing west end airlock must overcome obstacles. The interior airlock must be enlarged and bridging constructed for the wet storage basin. Without these modifications, width restrictions would be imposed on the transporter design and require operations with tight clearances both inside and outside the building. It would also constrain the initial packages to be removed to the more heavily contaminated A through E cells rather than the lightly contaminated I and H cells.

Removal of the hot cell package through a new door in the east end of the building offers the advantage of providing a least-cost approach. It could be justified if the overall radioactive inventory within the building was low enough and in a stable configuration and facility operations restricted during operation. The facility confinement boundary would be breached and activities restricted within the facility to ensure that there would be no airborne contamination. Although this option should be pursued as a possible cost reduction, the baseline was selected as the more conservative use of a Temporary Airlock Building, as discussed below.

Removal of hot cell package through a new door in the north side does not appear to offer any advantages over the east end. The major detriment is the requirement to make a 90° turn for access to most of the cells. Also, this would require movement of the heaviest cell, the SERF cell, first.

Recommended Baseline—Temporary Airlock Building

The recommended option, a new temporary airlock building (TAB) on the east end of the facility, was selected as conservative enough to be licensed/authorized with minimal risk. Figure A.1 shows the layout.

The approach meets the functions and requirements and provides various other advantages. The possible maximum width of the TAB door allows for a straightforward distribution of the load of the intact hot cell removal in-facility transporter as it exits the building. Further, the transporter can remove hot cell packages without requiring north-south movements to align with the airlock access. The TAB footprint can be made large enough that a hot cell package, if raised to an administratively controlled height not to exceed 2 meters, would not challenge the wall integrity if dropped onto an uneven surface (a partially removed transporter).

The TAB can probably be built to commercial quality because it would be designed for a limited service period and because the package would be low-level waste (LLW) (see discussion in Section 4.1) and capable of use by the over-the-road transporter. Thus the primary structural requirement would be that the facility not adversely impact the adjacent building boundary and that it be lightly enough constructed that its collapse in the highly unlikely event of a concurrent earthquake not pose an undo threat to the package.

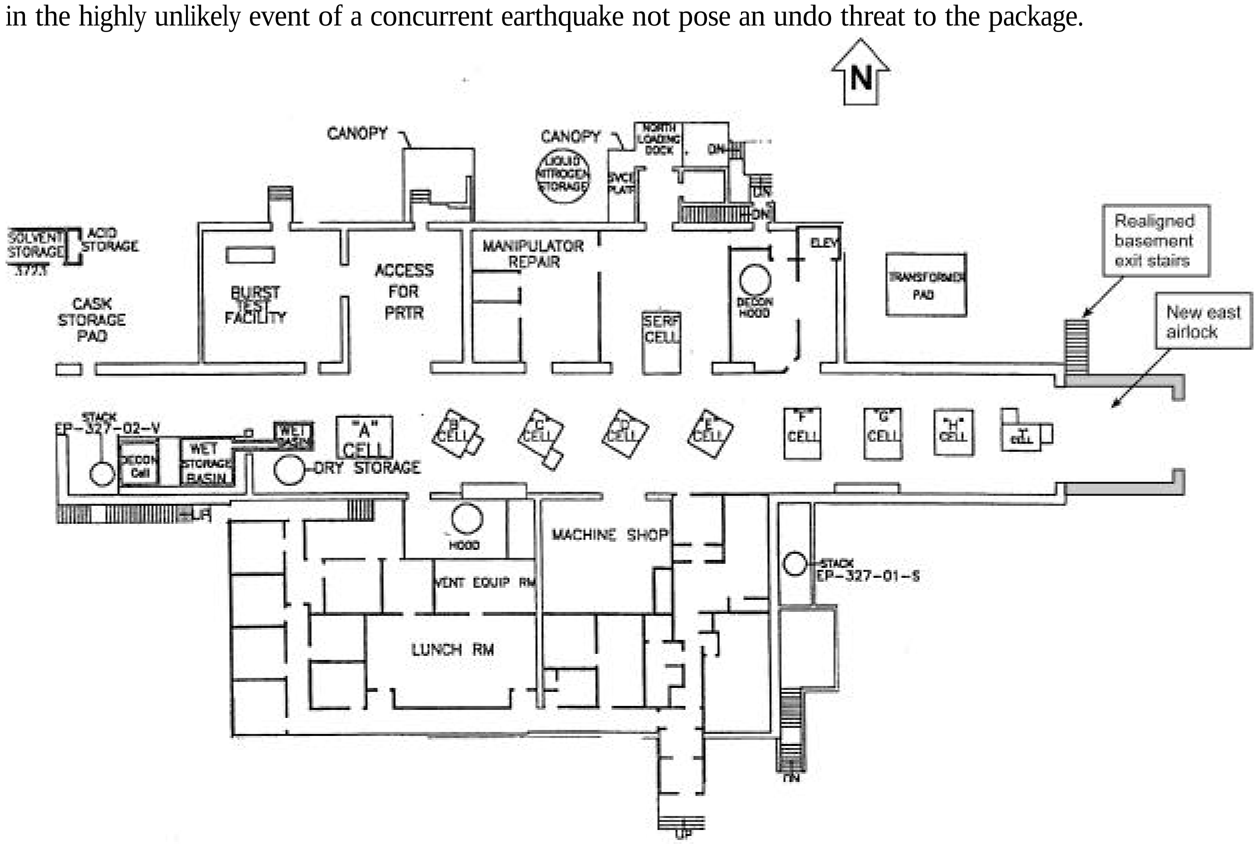


Figure A.1. 327 Building Floor Plan with New Temporary Airlock Building on the East End

The TAB should be evaluated to determine whether a less expensive option, such as direct access from the 327 Building to the heavy haul transporter via a door in the east face, can be justified. This would require 1) demonstrating that a package drop would be acceptable and 2) demonstrating that there is minimal risk of a release within the 327 Building when the east door is open, so that reduced confinement can be justified.

The package drop should be acceptable within certain constraints. Each individual hot cell package must be transported by a heavy haul transporter from the 327 Building to the 200 West Area. Because the hot cell will be packaged and shipped in accordance with an onsite approval (Section 5.2) document rather than the Department of Transportation (DOT) regulations, the road between the 300 Area and the Wye Barricade must be closed to public access during transport as specified by HNF-PRO-157.

Special conditions could be considered for operations during the reduced confinement period as well. Specifically, all locally contaminated areas would be stabilized, all activities not related to the transport would cease, and all hot local confinement ventilations systems would be operating during the transfer.

ATTACHMENT 5 - DECONTAMINATION ALTERNATIVES

In selecting a decontamination process or equipment, it is recognized that there is no single, ideal process to serve all decontamination applications. In most instances, it is necessary to have two or more techniques available to meet all the needs of the decontamination operators. Factors that affect the decontamination techniques chosen include the physical configuration of the equipment being decontaminated, whether the contamination is "smearable" or "fixed," the amount and type of secondary waste that can be handled, ease of operation, and whether cross-contamination is a concern.

Existing 327 Building hot-cell surveys indicate that minimal decontamination will be required to meet cell disposal criteria (Landsman et al. 1998). Most likely, only additional cleanup with swipes will be necessary. If more aggressive decontamination techniques are needed to remove fixed contamination and layered paint, one of the media blasting techniques is recommended so that no liquid secondary waste is generated. There are many commercially available blasting media available. The harder, more aggressive media are generally harder to dispose of than some of the softer, less-aggressive plastic media that are often certified incinerable.

For 327 Building decontamination, the proposed techniques are provided as workable solutions that should be used in progressive order of aggressiveness. The least aggressive techniques are generally the simplest and most cost-effective and may prove to be more than adequate. If additional decontamination is required, more aggressive techniques would then be used as appropriate for the physical characteristics of the equipment being decontaminated. In addition to those proposed, other techniques were considered but are not being recommended at this time. They may be reevaluated as necessary for specific decontamination needs the facility may have:

- low-pressure water wash
- ice blast
- carbon dioxide (CO_2) blasting
- general chemical decontamination
- high/ultra-high-pressure water
- mechanical scarifiers
- electropolishing
- ultrasonic cleaning
- laser treatment.

Criteria

For this application, there is a minimal number of closely defined physical parameters to be met. However, the following general values were identified that the system should meet:

- The system should be aggressive enough to reduce smearable and fixed contamination down to desired levels.
- The system should minimize the amount of secondary waste generated. If possible, it is desired that no liquid wastes be generated.
- The system or technique should be flexible enough to decontaminate a wide range of equipment.
- The system should be safe and easy to operate with a minimum of experience and training necessary.

- The system should minimize or eliminate the potential for cross contamination.
- The system should be cost-effective from both capital expenditure and operating standpoints.

Described below are decontamination alternatives pertinent to the cleanup of the hot cells should decontamination be necessary to achieve a LLW designation

Swipes

Dry swipes (rags) can be used to remove some portion of smearable contamination by simply wiping the contaminated surface. Some additional decontamination capability can be gained by wetting the swipe with water or mild cleaning solution. Swipes are a simple, quick, and inexpensive decontamination technique and may be all that is necessary in accessible locations where there is no fixed contamination. However, swipes cannot remove fixed contamination or certain complex geometries. It is generally a hands-on method, although simple remote tools can also be used to reduce personnel exposure.

Soft Blast Media Decontamination

There are several commercially available soft blast media systems that use a certified incinerable, proprietary soft blast media that will not damage the more delicate equipment to be decontaminated. Typical commercial systems use compressed air (80 psig minimum) to propel the blasting media. The blasting takes place in a specially designed glove box with a media reclaimer and dust collector or vacuum nozzle to recover the blast media and contaminants. The system exhaust is provided with a HEPA filter.

This technique has proven quite effective in decontaminating a wide range of materials and equipment. In some instances, varying degrees of aggressiveness are available to provide increased flexibility. Most of the blast media are recycled, but a certain percentage breaks down and must be disposed. No liquid secondary waste is generated. The more aggressive type would provide adequate decontamination for the 327 Building hot cells. Some blast media are capable of removing paint from the cell walls.

The technique can be very flexible with proper operator knowledge of the various blast media available and their properties. However, the equipment for this technique is fairly complex and requires a large amount of space. Used blast media will need to be characterized, packaged, and shipped offsite for disposal.

Hard Blast Media Decontamination

There are several commercially available hard blast media systems, including sand, steel grit, and steel shot. Most commercial systems use compressed air (80 psig minimum) to propel the blasting media. The blasting takes place in a specially designed glove box with a media reclaimer and dust collector or vacuum nozzle to recover the blast media and contaminants. System exhaust is provided with a HEPA filter.
This technique has proven quite effective in decontaminating a wide range of materials and equipment. Varying degrees of aggressiveness are available to provide increased flexibility. Most are recycled for continued use, but a certain percentage of it breaks down and must be disposed of.

No liquid secondary waste is generated by this technique, which is aggressive and can remove paint and some hard surface materials in the hot cells. The technique can be very flexible with proper operator knowledge of the different blast media available and their properties. However, the equipment is fairly complex and requires a fairly large amount of space. Used blast media will need to be characterized, packaged, and shipped offsite for disposal.

ATTACHMENT 6 - MEETING NOTES

Subject: Review of Heavy Lifting/Moving Ideas with Lampson International

Attendees: Rusty Rutherford, Lampson, Field Supervisor
Don Ball, Vista Engineering
Jim Thomson, Xwest
Marlin Lindquist, M&D Professional Services
Bill Jasen, Project Enhancement Corp.
Paul Day, Holmes & Narver

The purpose of the meeting was to review the team's ideas for removal of the hot cells from the 327 Building with a representative of Lampson to confirm that concepts under consideration were reasonable and obtain Lampson's input on ways to accomplish the task. Don Ball and the review team briefed Rusty on our concepts for hot cell removal and transport for burial.

Rusty had several ideas on how to accomplish what we outlined and confirmed we were on the right course from a lifting and moving standpoint. His ideas were the following:

- Lampson has several "6 line" trailers. Each has 6 axles with 8 tires per axle. The center 4 axles are driven and all axles are steerable. The unit is 32x12x5 ft (h), and the deck is flat and can lower about 2 ft. The unit unloaded weighs about 32 tons and has capacity to carry approximately 210 tons, or more than the heaviest hot cell or several of the smaller hot cells. The trailer cannot be towed over the highway, and has a speed of several mph.

  Rusty's first thought was to drive this unit onto the canyon deck and thus avoid the need for any internal transport vehicle. With this layout, the heaviest load, approximately 200 tons including trailer, appears to fit within the allowed floor loading of 20 tons per 3x3-ft section. With the axles spaced approximately 5 ft apart and set of two wheels per axle 3 ft apart on each side, the loading per wheel pair would be 16 tons. (See attached Goldhofer drawing.) However, with the relative slow speed of the unit, it appears to be best suited for just moving the cell outside the canyon for loading on another over-the-road trailer.

  A ramp would be required to drive the trailer up to canyon deck level and care would be required to keep the trailer contamination free for this to work. Also, any large openings left in the canyon deck would have to be bridged when the trailer was required to pass over them.

  - A 4-axle trailer could also be used, but currently Lampson doesn't have any of these. It would be shortened to approximately 24 ft long.
  - Lampson moves heavy objects using a steel plate on either steel rollers (100 tons each) or 2-in.-thick Teflon sheets. This could be used to rotate cells if necessary or even drag them to the load-out area.

Figure A.2 is a drawing depicting the 6-axle unit. In this figure, four of these units are ganged together and dimensions shown are in mm.

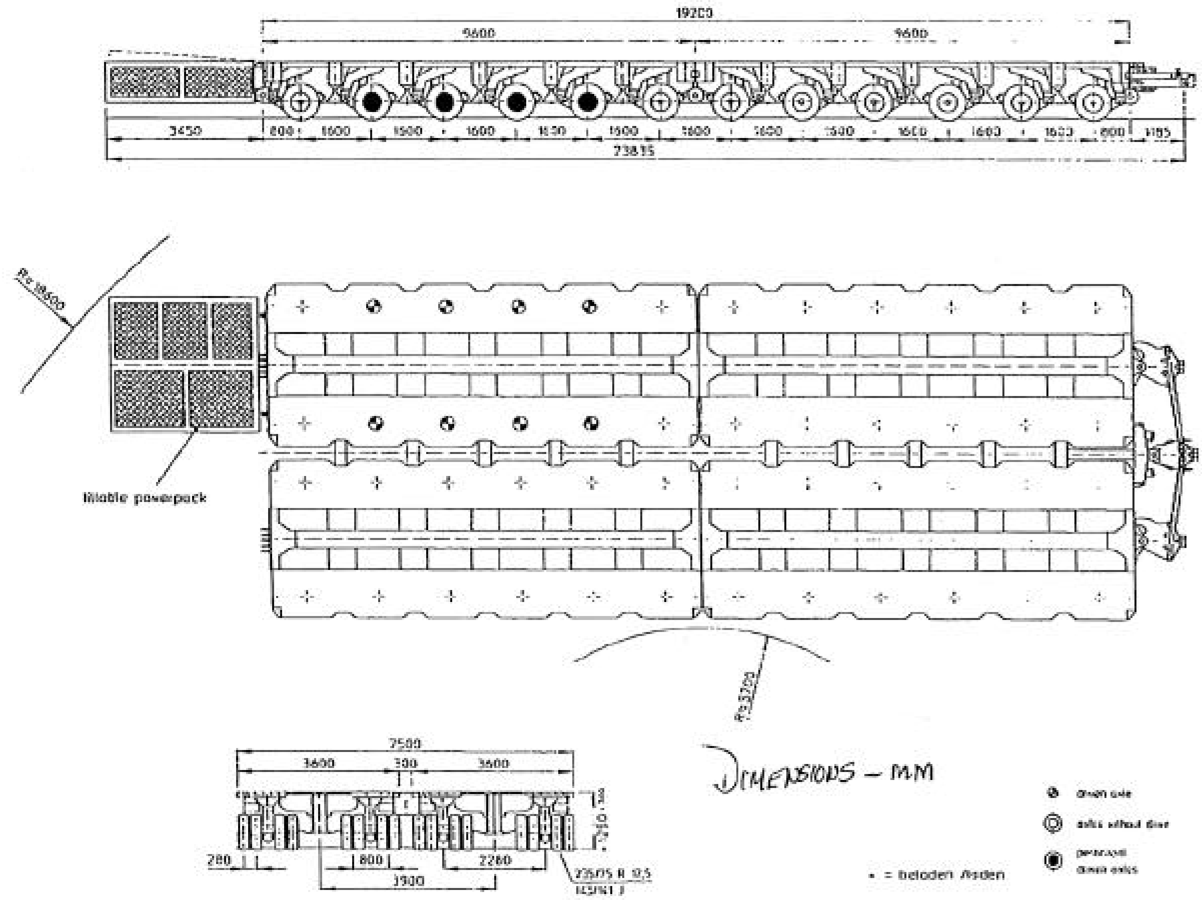


Figure A.2. Lampson's Six-Axle Unit

ATTACHMENT 7 - TRANSPORT PACKAGE CALCULATIONS

For preliminary evaluation of the proposed hot cell package, the residual contamination characterization data provided by Table 4-1 of Landsman et al. (1998) was used. Of cells A through I, the highest total activity is indicated for the F cell.

As a scoping analysis only, the F Cell radionuclide data were input to the RadCalc for Windows Version 2.11 program, and an effective A_2 value of 0.163 curies was calculated. Several scoping calculations using varying decay times did not significantly change the A_2 value. The A_2 calculation is essentially a "sum of the fractions" of all of the radionuclides to determine a single value that is representative of the total quantity of the radionuclides for the determination of a graded DOT packaging category. F Cell has a unity fraction of 0.19, which is a measure of how close to a Type A quantity (unity, or 1.0) is represented by its total quantity of radionuclides. A unity fraction greater than 1.0 indicates a Type B quantity, which requires a much more substantive packaging under the DOT regulations.

From the F Cell calculation, it was noted that the effective A_2 was driven by the americium and plutonium radionuclides. From Table 4-1 of Landsman et al. (1998), G cell has the highest quantities of these radionuclides. Another RadCalc analysis was performed for the G cell data, and, as expected, a lower effective A_2 value of 0.0284 curies was calculated. Given the quantities of radionuclides in G cell and its lower effective A_2 resulted in a unity fraction of 0.23, which indicates that it is likely the worst case of the cells A through I (because it has the most alpha, which drives the A_2 value down).

A third RadCalc analysis was performed for the SERF cell as a supplementary evaluation. The results show an A_2 of 0.292 curies and a unity fraction of 0.45. Therefore, although the allowable A_2 quantity allowed in a Type A package is higher than the G and F cells, its total quantity of radionuclides is much higher. In any case, the F, G, and SERF cells are all in the same DOT classification (Type A).

In very simplistic terms, if the total activity in the package is greater than the A_2 value (i.e., unity fraction greater than 1.0), it is a "Type B" package that must meet mandated performance requirements for normal conditions of transport and hypothetical accident conditions. If the total activity is less than an A_2, the package must meet "Type A" performance requirements for normal conditions only. DOT also has several categories of "excepted" packages for when the total activity meets defined levels that are orders of magnitude less than an A_2 or are volumetrically (A_2/gram) or areal (A_2/cm^2) determined to be relatively diluted. Excepted packages are generally only expected to meet industrial (e.g., "strong tight") levels of performance and are exempted from certain shipping communication requirements (such as labeling and placarding).

The results of the scoping evaluation of the F, G, and SERF cells indicates that their packaging will be in the Type A category, because their total activities are less than their A_2 values. For the worst-case cell (SERF), the calculation indicates that the contamination could be two times higher than that represented in Table 4-1, and still meet the Type A limit.

It is also worth noting that, when the Table 4-1 contamination is spread on an areal basis by dividing each cell's total activity by its specified total surface area, the cells may meet the DOT excepted requirements of a "Surface Contaminated Object I" (SCO-I, 49 CFR 173.403), which allows the use of a "strong tight" packaging. This is based only on the internal residual contamination; the regulations also specify certain dose rates and external contamination levels that cannot be verified here. But this simplistic observation is another indicator that the packaging requirements for the cells will not be stringent.

As a bounding evaluation, a fourth RadCalc calculation was performed for the SERF cell using a higher alpha source that is based on 15 grams of plutonium-239. This source term specification is from the draft BIO (FH 2000a) and states that the plutonium holdup in each hot cell is 10 to 15 grams. The results show an A_2 of 0.00578 curies and a unity fraction of 358, which is well beyond a Type A quantity (i.e., Type B). This indicates a need for additional source term characterization and/or decontamination of the hot cells. Realistically, it is likely that the actual source term will lie somewhere between the BIO and Table 4-1. Even at the higher levels however, additional safety basis evaluations would likely indicate that the movement of the hot cells "as-is" would be preferable to either dismantlement or overpacking in a Type B packaging—no Type B package exists for a payload of this size and weight.

The results of these scoping calculations indicate that the 327 Building hot cells should not require packagings that meet Type B "hypothetical accident condition" performance levels as long as the source term is in the range provided by Landsman et al. (1998, Table 4-1). However, building a Type A or "strong tight" packaging, such as a metal box, is not a trivial matter due to the extremely large weight and dimensions of the hot cells. The only way to ship the hot cells under DOT in an "as-is" (grouted, sealed, exterior decontaminated, but unpackaged) condition would be under a DOT exemption, which requires preparing an application for approval by the DOT. Such an application would be required if, for example, the hot cells were to be shipped off the Hanford Site. The Hanford Site transportation and packaging program allows using an "equivalent degree of safety" in lieu of total compliance with DOT. Therefore, it is proposed that the hot cells be shipped, essentially as-is, in accordance with the Hanford onsite packaging and transportation program that is allowed under DOE Order 460.1A and Fritz (2000a).

F-CELL SCOPING CALCULATION

Radcalc for Windows 2.11 Date: 01-23-01 14:38

Performed By: RJ Smith

File: 327FCELL.RAD Checked By: _JG Field, 03-02-01

========== Input Information ==

Source from input:

Radionuclide	Curies	Becquerels	Grams
Co-60	1.00E-005	3.70E+005	8.85E-009
Sr-90	8.06E-003	2.98E+008	5.71E-005
Cs-134	2.00E-005	7.40E+005	1.55E-008
Cs-137	2.17E-002	8.03E+008	2.50E-004
Eu-154	5.00E-005	1.85E+006	1.85E-007
Eu-155	3.00E-005	1.11E+006	6.09E-008
Pu-238	2.40E-004	8.88E+006	1.41E-005
Pu-239	2.40E-004	8.88E+006	3.87E-003
Pu-240	2.40E-004	8.88E+006	1.04E-003
Am-241	2.80E-004	1.04E+007	8.17E-005
Cm-242	4.00E-007	1.48E+004	1.21E-010
Cm-243	2.00E-006	7.40E+004	3.87E-008
Cm-244	2.00E-006	7.40E+004	2.47E-008
Total Activity	3.09E-002	1.14E+009	
Total Minus Daughters:	3.09E-002	1.14E+009	

Waste Form:	Normal
Physical Form:	Solid
Container Type:	6 x 6 Liner
Package Void Volume:	0.000 cc
Waste Volume:	0.000 cc
Waste Mass:	0.000 g
Waste Void Volume:	0.000 cc
Days to decay source before seal time:	1.00 days
Days container is sealed:	0.00 days

Entered G Values:

G Alpha	G Beta	G Gamma
0	0	0

Comments:
A2 Calculation for 327 F-Cell

========== Calculated Results ==

DECAY HEAT:
Heat Generated at seal time: 0.000158 Watts

TRANSPORTATION:
Note: Transportation classifications assume three significant figures.
Calculations are made at user-specified decay time.

Radioactive:	Not Calculated
Effective A2 for Mixture:	0.163 Ci
Type Determination:	A (from unity fraction 0.18987)
Limited Quantity:	No
LSA-I Determination:	Not Calculated
LSA-II Determination:	Not Calculated
LSA-III Determination:	Not Calculated
HRC Quantity Determination:	No
Fissile Quantity:	0.00389 g
Fissile Excepted:	Yes

15g fissile radionuclides or less per 49CFR173.453(a)

Container Category:	III (Container Category per Reg Guide 7.11)
TRU Waste:	Not Calculated
Reportable Quantity:	No (from RQ unity fraction 0.203)

Source at start of seal time:

Radionuclide:	Curies	Becquerels	Grams:
Co-60	1.00E-005	3.70E+005	8.84E-009
Sr-90	8.06E-003	2.98E+008	5.71E-005
Y-90	1.84E-003	6.83E+007	3.40E-009 (Daughter)
Cs-134	2.00E-005	7.39E+005	1.54E-008
Cs-137	2.17E-002	8.03E+008	2.50E-004
Ba-137m	2.05E-002	7.60E+008	3.82E-011 (Daughter)
Eu-154	5.00E-005	1.85E+006	1.85E-007
Eu-155	3.00E-005	1.11E+006	6.08E-008
Pu-238	2.40E-004	8.88E+006	1.41E-005
U-234	1.86E-012	6.89E-002	3.00E-010
Pu-239	2.40E-004	8.88E+006	3.87E-003
U-235	6.47E-016	2.39E-005	2.94E-010
Pu-240	2.40E-004	8.88E+006	1.04E-003
U-236	1.95E-014	7.20E-004	3.01E-010
Am-241	2.80E-004	1.04E+007	8.17E-005
Np-237	2.48E-013	9.19E-003	3.52E-010
Cm-242	3.98E-007	1.47E+004	1.20E-010
Cm-243	2.00E-006	7.40E+004	3.87E-008
Cm-244	2.00E-006	7.40E+004	2.47E-008
Total Activity:	5.33E-002	1.97E+009	
Total Minus Daughters:	3.09E-002	1.14E+009	

Shipping Papers and Labels:

Isotope	Number of A2s	Fraction of Total A2s	Cumulative Total A2s
* Am-241	5.18E-002	2.73E-001	0.272579
* Pu-239	4.44E-002	2.34E-001	0.506219
* Pu-240	4.44E-002	2.34E-001	0.739858
* Pu-238	4.44E-002	2.34E-001	0.973493
Sr-90	2.98E-003	1.57E-002	0.989214
Cs-137	1.61E-003	8.47E-003	0.997683
Cm-243	2.47E-004	1.30E-003	0.998982
Cm-244	1.85E-004	9.75E-004	0.999957
Eu-154	3.70E-006	1.95E-005	0.999977
Cs-134	1.48E-006	7.80E-006	0.999984
Cm-242	1.48E-006	7.77E-006	0.999992
Co-60	9.26E-007	4.87E-006	0.999997
Eu-155	5.54E-007	2.92E-006	1.00000
U-234	6.90E-011	3.63E-010	1.00000
Np-237	4.59E-011	2.42E-010	1.00000
U-236	7.20E-013	3.79E-012	1.00000
Ba-137m	0.00E+000	0.00E+000	1.00000
U-235	0.00E+000	0.00E+000	1.00000
Y-90	0.00E+000	0.00E+000	1.00000

* Contains 95% of the total A2s and must be included per 49 CFR 173.433.

G-CELL SCOPING CALCULATION

Radcalc for Windows 2.11 Date: 01-25-01 14:11

Performed By: RJ Smith

Checked By: JG Field, 03-02-01

File: 327GCELL.RAD

========== Input Information ==

Source from input:

Radionuclide	Curies	Becquerels	Grams:
Co-60	9.58E-006	3.54E+005	8.48E-009
Sr-90	3.61E-003	1.34E+008	2.56E-005
Cs-134	4.00E-005	1.48E+006	3.09E-008
Cs-137	1.66E-003	6.15E+007	1.91E-005
Eu-154	4.00E-005	1.48E+006	1.48E-007
Eu-155	2.00E-005	7.40E+005	4.06E-008
Ra-226	1.14E-006	4.22E+004	1.15E-006
Pu-238	3.55E-004	1.31E+007	2.09E-005
Pu-239	2.59E-004	9.58E+006	4.18E-003
Pu-240	2.59E-004	9.58E+006	1.13E-003
Am-241	3.84E-004	1.42E+007	1.12E-004
Cm-242	6.00E-007	2.22E+004	1.81E-010
Cm-243	2.00E-006	7.40E+004	3.87E-008
Cm-244	2.00E-006	7.40E+004	2.47E-008
Total Activity:	6.64E-003	2.46E+008	
Total Minus Daughters:	6.64E-003	2.46E+008	

Waste Form:	Normal
Physical Form:	Solid
Container Type:	6 x 6 Liner
Package Void Volume:	0.000 cc
Waste Volume:	0.000 cc
Waste Mass:	0.000 g
Waste Void Volume:	0.000 cc
Days to decay source before seal time:	1.00 days
Days container is sealed:	0.00 days

Entered G Values:

G Alpha	G Beta	G Gamma
0	0	0

Comments:

A2 Calculation for 327 G-Cell

========== Calculated Results ==

DECAY HEAT:
Heat Generated at seal time: 5.86E-005 Watts

TRANSPORTATION:
Note: Transportation classifications assume three significant figures.
Calculations are made at user-specified decay time.

Radioactive:	Not Calculated
Effective A2 for Mixture:	0.0284 Ci
Type Determination:	A (from unity fraction 0.23425)
Limited Quantity:	No
LSA-I Determination:	Not Calculated
LSA-II Determination:	Not Calculated
LSA-III Determination:	Not Calculated
HRC Quantity Determination:	No
Fissile Quantity:	0.00420 g
Fissile Excepted:	Yes
15g fissile radionuclides or less per 49CFR173.453(a)	
Container Category:	III (Container Category per Reg Guide 7.11)
TRU Waste:	Not Calculated
Reportable Quantity:	No (from RQ unity fraction 0.164)

Source at start of seal time:

Radionuclide	Curies	Becquerels	Grams
Co-60	9.58E-006	3.54E+005	8.47E-009
Sr-90	3.61E-003	1.34E+008	2.56E-005
Y-90	8.26E-004	3.06E+007	1.52E-009 (Daughter)
Cs-134	4.00E-005	1.48E+006	3.09E-008
Cs-137	1.66E-003	6.15E+007	1.91E-005
Ba-137m	1.57E-003	5.81E+007	2.92E-012 (Daughter)
Eu-154	4.00E-005	1.48E+006	1.48E-007
Eu-155	2.00E-005	7.40E+005	4.06E-008
Ra-226	1.14E-006	4.22E+004	1.15E-006
Rn-222	1.89E-007	6.99E+003	1.23E-012 (Daughter)
Po-218	1.88E-007	6.97E+003	6.77E-016 (Daughter)
Pb-214	1.84E-007	6.80E+003	5.61E-015 (Daughter)
Bi-214	1.80E-007	6.67E+003	4.08E-015 (Daughter)
Po-214	1.80E-007	6.67E+003	5.62E-022 (Daughter)
Pb-210	7.51E-012	2.78E-001	9.83E-014
Bi-210	3.23E-013	1.20E-002	2.61E-018 (Daughter)
Po-210	3.92E-016	1.45E-005	8.71E-020
Pu-238	3.55E-004	1.31E+007	2.09E-005
U-234	2.76E-012	1.02E-001	4.43E-010
Th-230	3.40E-020	1.26E-009	1.65E-018
Pu-239	2.59E-004	9.58E+006	4.18E-003

U-235	6.98E-016	2.58E-005	3.17E-010
Pu-240	2.59E-004	9.58E+006	1.13E-003
U-236	2.10E-014	7.77E-004	3.25E-010
Am-241	3.84E-004	1.42E+007	1.12E-004
Np-237	3.41E-013	1.26E-002	4.83E-010
Cm-242	5.97E-007	2.21E+004	1.80E-010
Cm-243	2.00E-006	7.40E+004	3.87E-008
Cm-244	2.00E-006	7.40E+004	2.47E-008
Total Activity:	9.04E-003	3.35E+008	
Total Minus Daughters:	6.64E-003	2.46E+008	

Shipping Papers and Labels:

Isotope	**Number of A2s**	**Fraction of Total A2s**	**Cumulative Total A2s**
* Am-241	7.10E-002	3.03E-001	0.303008
* Pu-238	6.56E-002	2.80E-001	0.583128
* Pu-239	4.79E-002	2.04E-001	0.787502
* Pu-240	4.79E-002	2.04E-001	0.991875
Sr-90	1.34E-003	5.71E-003	0.997583
Cm-243	2.47E-004	1.05E-003	0.998635
Cm-244	1.85E-004	7.90E-004	0.999426
Cs-137	1.23E-004	5.25E-004	0.999951
Eu-154	2.96E-006	1.26E-005	0.999964
Cs-134	2.96E-006	1.26E-005	0.999976
Cm-242	2.21E-006	9.45E-006	0.999986
Ra-226	2.11E-006	9.00E-006	0.999995
Co-60	8.87E-007	3.79E-006	0.999998
Eu-155	3.70E-007	1.58E-006	1.00000
U-234	1.02E-010	4.36E-010	1.00000
Np-237	6.29E-011	2.69E-010	1.00000
Pb-210	3.09E-011	1.32E-010	1.00000
U-236	7.77E-013	3.32E-012	1.00000
Po-210	7.24E-016	3.09E-015	1.00000
Th-230	6.28E-018	2.68E-017	1.00000
Y-90	0.00E+000	0.00E+000	1.00000
U-235	0.00E+000	0.00E+000	1.00000
Rn-222	0.00E+000	0.00E+000	1.00000
Po-214	0.00E+000	0.00E+000	1.00000
Bi-214	0.00E+000	0.00E+000	1.00000
Bi-210	0.00E+000	0.00E+000	1.00000
Po-218	0.00E+000	0.00E+000	1.00000
Ba-137m	0.00E+000	0.00E+000	1.00000
Pb-214	0.00E+000	0.00E+000	1.00000

* Contains 95% of the total A2s and must be included per 49 CFR 173.433.

SERF CELL SCOPING CALCULATION

Radcalc for Windows 2.11 Date: 01-25-01 14:41

Performed By: RJ Smith

Checked By: JG Field, 03-02-01

File: 327SERF.RAD

========== Input Information ==

Source from input:

Radionuclide	Curies	Becquerels	Grams
Sr-90	6.84E-004	2.53E+007	4.85E-006
Cs-134	1.82E-003	6.72E+007	1.40E-006
Cs-137	1.25E-001	4.61E+009	1.43E-003
Eu-155	8.90E-004	3.29E+007	1.81E-006
Pu-238	1.20E-004	4.44E+006	7.06E-006
Pu-239	1.50E-004	5.55E+006	2.42E-003
Pu-240	1.50E-004	5.55E+006	6.52E-004
Am-241	1.94E-003	7.18E+007	5.66E-004
Cm-242	3.00E-006	1.11E+005	9.06E-010
Cm-243	4.00E-006	1.48E+005	7.75E-008
Cm-244	4.00E-006	1.48E+005	4.94E-008
Total Activity:	1.30E-001	4.83E+009	
Total Minus Daughters:	1.30E-001	4.83E+009	

Waste Form:	Normal
Physical Form:	Solid
Container Type:	6 x 6 Liner
Package Void Volume:	0.000 cc
Waste Volume:	0.000 cc
Waste Mass:	0.000 g
Waste Void Volume:	0.000 cc
Days to decay source before seal time:	1.00 days
Days container is sealed:	0.00 days

Entered G Values:

G Alpha	G Beta	G Gamma
0	0	0

Comments:
A2 Calculation for 327 SERF-Cell

========== Calculated Results ==

DECAY HEAT:

Heat Generated at seal time: 0.000701 Watts

TRANSPORTATION:

Note: Transportation classifications assume three significant figures.
Calculations are made at user-specified decay time.

Radioactive:	Not Calculated
Effective A2 for Mixture:	0.292 Ci
Type Determination:	A (from unity fraction 0.44674)
Limited Quantity:	No
LSA-I Determination:	Not Calculated
LSA-II Determination:	Not Calculated
LSA-III Determination:	Not Calculated
HRC Quantity Determination:	No
Fissile Quantity:	0.00243 g
Fissile Excepted:	Yes

15g fissile radionuclides or less per 49CFR173.453(a)

Container Category:	III (Container Category per Reg Guide 7.11)
TRU Waste:	Not Calculated
Reportable Quantity:	No (from RQ unity fraction 0.370)

Source at start of seal time:

Radionuclide	Curies	Becquerels	Grams:
Sr-90	6.84E-004	2.53E+007	4.85E-006
Y-90	1.57E-004	5.79E+006	2.88E-010 (Daughter)
Cs-134	1.81E-003	6.71E+007	1.40E-006
Cs-137	1.25E-001	4.61E+009	1.43E-003
Ba-137m	1.18E-001	4.36E+009	2.19E-010 (Daughter)
Eu-155	8.90E-004	3.29E+007	1.81E-006
Pu-238	1.20E-004	4.44E+006	7.06E-006
U-234	9.31E-013	3.45E-002	1.50E-010
Pu-239	1.50E-004	5.55E+006	2.42E-003
U-235	4.04E-016	1.50E-005	1.84E-010
Pu-240	1.50E-004	5.55E+006	6.52E-004
U-236	1.22E-014	4.50E-004	1.88E-010
Am-241	1.94E-003	7.18E+007	5.66E-004
Np-237	1.72E-012	6.37E-002	2.44E-009
Cm-242	2.99E-006	1.11E+005	9.02E-010
Cm-243	4.00E-006	1.48E+005	7.75E-008
Cm-244	4.00E-006	1.48E+005	4.94E-008
Total Activity:	2.48E-001	9.19E+009	
Total Minus Daughters:	1.30E-001	4.83E+009	

Shipping Papers and Labels:

Isotope	Number of A2s	Fraction of Total A2s	Cumulative Total A2s
* Am-241	3.59E-001	8.03E-001	0.802691
* Pu-239	2.77E-002	6.21E-002	0.864755
* Pu-240	2.77E-002	6.21E-002	0.926819
* Pu-238	2.22E-002	4.97E-002	0.976469
Cs-137	9.23E-003	2.07E-002	0.997138
Cm-243	4.93E-004	1.10E-003	0.998242
Cm-244	3.70E-004	8.29E-004	0.999071
Sr-90	2.53E-004	5.67E-004	0.999638
Cs-134	1.34E-004	3.01E-004	0.999938
Eu-155	1.64E-005	3.68E-005	0.999975
Cm-242	1.11E-005	2.48E-005	1.00000
Np-237	3.18E-010	7.12E-010	1.00000
U-234	3.45E-011	7.72E-011	1.00000
U-236	4.50E-013	1.01E-012	1.00000
Y-90	0.00E+000	0.00E+000	1.00000
U-235	0.00E+000	0.00E+000	1.00000
Ba-137m	0.00E+000	0.00E+000	1.00000

* Contains 95% of the total A_2s and must be included per 49 CFR 173.433.

SERF CELL SCOPING CALCULATION WITH HNF-4667 (FH 2000A) SOURCE

Radcalc for Windows 2.11 Date: 02-07-01 11:30

Performed By: RJ Smith

Checked By: JG Field 03-02-01

File: SERFBIO.RAD
========== Input Information ==
Source from input:

Radionuclide	Curies	Becquerels	Grams
Sr-90	6.84E-004	2.53E+007	4.85E-006
Cs-134	1.82E-003	6.72E+007	1.40E-006
Cs-137	1.25E-001	4.61E+009	1.43E-003
Eu-155	8.90E-004	3.29E+007	1.81E-006
Pu-238	9.30E-002	3.44E+009	5.47E-003
Pu-239	1.12E-001	4.13E+009	1.80E+000
Pu-240	1.12E-001	4.13E+009	4.85E-001
Am-241	1.62E+000	5.99E+010	4.72E-001
Cm-242	1.86E-003	6.88E+007	5.62E-007
Cm-243	3.72E-003	1.38E+008	7.21E-005
Cm-244	3.72E-003	1.38E+008	4.60E-005
Total Activity:	2.07E+000	7.67E+010	
Total Minus Daughters:	2.07E+000	7.67E+010	

Waste Form:	Normal
Physical Form:	Solid
Container Type:	6 x 6 Liner
Package Void Volume:	0.000 cc
Waste Volume:	0.000 cc
Waste Mass:	0.000 g
Waste Void Volume:	0.000 cc
Days to decay source before seal time:	1.00 days
Days container is sealed:	0.00 days

Entered G Values:

G Alpha	G Beta	G Gamma
0	0	0

Comments:
A2 Calculation for 327 SERF-Cell using 15 gm Pu-239 ratio values.

========== Calculated Results ==
DECAY HEAT:
Heat Generated at seal time: 0.0650 Watts

TRANSPORTATION:
Note: Transportation classifications assume three significant figures.
Calculations are made at user-specified decay time.

Radioactive:	Not Calculated
Effective A2 for Mixture:	0.00578 Ci
Type Determination:	B (from unity fraction 358.38)
Limited Quantity:	No
LSA-I Determination:	Not Calculated
LSA-II Determination:	Not Calculated
LSA-III Determination:	Not Calculated
HRC Quantity Determination:	No
Fissile Quantity:	1.81 g
Fissile Excepted:	Yes
15g fissile radionuclides or less per 49CFR173.453(a)	
Container Category:	II (Container Category per Reg Guide 7.11)
TRU Waste:	Not Calculated
Reportable Quantity:	Yes (from RQ unity fraction 194.)

Source at start of seal time:

Radionuclide	Curies	Becquerels	Grams:
Sr-90	6.84E-004	2.53E+007	4.85E-006
Y-90	1.57E-004	5.79E+006	2.88E-010 (Daughter)
Cs-134	1.81E-003	6.71E+007	1.40E-006
Cs-137	1.25E-001	4.61E+009	1.43E-003
Ba-137m	1.18E-001	4.36E+009	2.19E-010 (Daughter)

Eu-155	8.90E-004	3.29E+007	1.81E-006
Pu-238	9.30E-002	3.44E+009	5.47E-003
U-234	7.22E-010	2.67E+001	1.16E-007
Th-230	8.89E-018	3.29E-007	4.31E-016
Pu-239	1.12E-001	4.13E+009	1.80E+000
U-235	3.01E-013	1.11E-002	1.37E-007
Pu-240	1.12E-001	4.13E+009	4.85E-001
U-236	9.05E-012	3.35E-001	1.40E-007
Th-232	6.11E-025	2.26E-014	5.57E-018
Am-241	1.62E+000	5.99E+010	4.72E-001
Np-237	1.44E-009	5.31E+001	2.04E-006
Pa-233	1.83E-011	6.76E-001	8.80E-016
U-233	7.30E-020	2.70E-009	7.53E-018
Cm-242	1.85E-003	6.85E+007	5.59E-007
Cm-243	3.72E-003	1.38E+008	7.21E-005
Cm-244	3.72E-003	1.38E+008	4.60E-005
Total Activity:	2.19E+000	8.10E+010	
Total Minus Daughters:	2.07E+000	7.67E+010	

Shipping Papers and Labels:

Isotope	**Number of A_2s**	**Fraction of Total A_2s**	**Cumulative Total A_2s**
* Am-241	2.99E+002	8.35E-001	0.834626
* Pu-239	2.06E+001	5.76E-002	0.892186
* Pu-240	2.06E+001	5.76E-002	0.949747
* Pu-238	1.72E+001	4.80E-002	0.997713
Cm-243	4.59E-001	1.28E-003	0.998993
Cm-244	3.44E-001	9.61E-004	0.999954
Cs-137	9.23E-003	2.58E-005	0.999980
Cm-242	6.86E-003	1.91E-005	0.999999
Sr-90	2.53E-004	7.07E-007	1.00000
Cs-134	1.34E-004	3.75E-007	1.00000
Eu-155	1.64E-005	4.59E-008	1.00000
Np-237	2.65E-007	7.40E-010	1.00000
U-234	2.67E-008	7.46E-011	1.00000
U-236	3.35E-010	9.35E-013	1.00000
Pa-233	7.52E-013	2.10E-015	1.00000
Th-230	1.64E-015	4.59E-018	1.00000
U-233	2.71E-018	7.55E-021	1.00000
Y-90	0.00E+000	0.00E+000	1.00000
Th-232	0.00E+000	0.00E+000	1.00000
Ba-137m	0.00E+000	0.00E+000	1.00000
U-235	0.00E+000	0.00E+000	1.00000

* Contains 95% of the total A_2s and must be included per 49 CFR 173.433.

ATTACHMENT 8 - RECOMMENDED ALTERNATIVE IMPLEMENTATION RISK AND COST ANALYSIS

An evaluation was carried out to address intact cell removal implementation in terms of deployment costs and management risks. The cost and risk information needed to be definitive enough to assess the question of implementation of the recommended alternative and, if selected, provide the framework for the development of a credible baseline change request by the Project. Using the step-by-step deployment scenario described in Section 4 as a basis to proceed, a two-part approach to assess cost and risk is described in this attachment.

COST ASSESSMENT

The cost assessment was carried out to

- Identify the estimated implementation costs for intact cell removal alternative.
- Compare the current baseline costs with the intact cell removal alternative.

Cost Assessment Approach

A Work Breakdown Schedule (WBS) provided as Table A.1, was developed that represented the recommended strategy. A preliminary cost estimate was then prepared using known costs for similar activities in the current project baseline, discussions with typical subcontractors, information regarding commercially available items, and applicable experience with management of authorization basis issues. This provided the elements of a resource estimate to deploy the intact cell removal option and also a basis to compare these deployment costs with the current baseline. Key assumptions developed to support this analysis are provided in Table A.2. A summary of this cost estimate is provided in Table A.3. Available backup and supplemental information is provided as a numbered Enclosure to this Attachment. For example, backup information for WBS 4.1 is located in Enclosure 8-4.1

Table A.1. Preliminary Cost Estimate WBS

1.0	**Characterization and Inventory Certification** *Include radiological and chemical characterization of cell internals and physical characterization of cell design, fabrication, and installation details. Radiological and chemical characterization is required to support inventory certification, and physical characterization is required to support detailed design and planning for cell removal.*
1.1	**Prepare Characterization Plan[a]**
1.2	**Collect Samples**
1.3	**Conduct Analysis (engineering study)**
1.4	**Inventory Certification (report)** *Provide the formal certification to permit transportation and burial as LLW with or without mixed waste constituents.*
2.0	**Cell Cleanout and Isolation** Complete cell internal cleanout only to the degree required for certification as LLW. Clean out under pedestal mounted cells. Include all efforts required to isolate the cells from facility systems and severing of all floor-mounting attachments in preparation for cell lifting.
2.1	**Remove small equipment and waste to A Cell, load into drums[b]**
2.2	**Remove floor liner, cut up, and load into paint cans[b]**
2.3	**Cut utilities (air supply, electrical, process drain, and HVAC)**
2.4	**Liquid decontamination processing[b]**
2.5	**Seal cell (epoxy, silicon, tape/plastic)**
2.6	**Remove manipulator and install plugs[b]**
2.7	**Cut cell anchors**

Table A.1. (Contd)

3.0	**Lift Package Design, Fabrication, Installation, and Initial Cell Lifting**
3.1	**Lift package design by heavy lift contractor after fixed-price procurement** Both preliminary and final design and fabrication. Include design reviews, as required to support heavy lift requirement and required jacking equipment. Assume fixed-price procurement.
3.2	**Lift package installation, lifting and final cell isolation** Installation of all lift packages and jacking equipment. Initial lifting of the cell off its foundation, completion of cell isolation including installation of cover on the bottom of the cell, and installation of grout nozzles, valves, and breather filters and any other packaging required to meet transportation and burial requirements. Note: Installation and lifting scope to be part of fixed-price procurement of heavy lift contractor.
4.0	**Design and Implement Facility Modifications**
4.1	**East end building modifications** Required changes to open the east end of the facility for cell removal. Range of costs to include options with and without an exterior shell added to act as an air lock.
4.2	**Floor shoring** Analysis of current floor loading capabilities. Engineering analysis.
5.0	**Heavy Lift Contract** Fixed-price contract.
5.1	**327 Facility Activities** Final jacking, loading, and internal transport of cells through the east end exit. Includes all transport equipment and labor.
5.2	**Transport and Unloading** Transport of cell to burial grounds and support for unloading. Transport could be with same vehicle used for internal transport or cell transferred to another over the road transporter. Unloading support as required at burial grounds.
6.0	**Burial Ground Costs** Burial ground costs based on LLBG disposal, including grouting in place. Unloading by crane using site forces.
7.0	**Safety and Regulatory Documentation**
7.1	**Safety Documentation** All required revisions and approvals to facility safety documentation.
7.2	**Transportation** All required documentation/support required to meet on-site transportation requirements.
7.3	**Regulatory Process** CERCLA disposal option with EECA
8.0	**Project Management**

(a) Include Bechtel Hanford Incorporated (BHI)-required information for waste certification to support the EECA process described in WBS 7.3.

(b) Denotes activity in current 327 Building baseline that would not be required by the recommended intact cell removal process.

Table A.2. Preliminary Cost Estimate Assumptions

WBS	Cost Estimate Assumptions[a]
General	The duration for all intact removal activities will be three years (FY02 through FY04)[b]
General	Resources to remove fuel and 30 waste buckets are not included; both of these activities will be completed prior to implementation of the intact cell removal recommendation.
General	Assume top portion of SERF will be addressed in the same manner as all other cells
1.1	Resources will be included to provide BHI-required information for certification (see WBS 7.3) and EECA process.
1.2	Manipulators/tooling in cells will be available/maintained to obtain characterization samples.
2.1	Some equipment removal and some level of decontamination may be necessary in the cells.
5.0	Cells to be cleaned out only to the extent necessary to meet non-TRU burial requirements.
5.2	Cells will be transported to the burial area in one campaign consisting of seven trips using the heavy-lift equipment provided by a support contractor.
6.0	LLBG costs are included in the event that approval to apply CERCLA requirements is not granted.

(a) See also information provided in WBS-specific enclosures at the end of this attachment.
(b) Figure A.8 provides a 19-month schedule for G cell that was used as a basis to build a preliminary estimate. This time period relates to intact removal for all cells.

Table A.3. Cost Estimate Summary

WBS Element	WBS Sub-Task	Title	Total Cost
1.0		**Characterization & Inventory Certification**	
	1.1	Characterization Plan	**$60,376**
	1.2	Obtain Samples	**$98,658**
	1.3	Sample Analysis	**$64,788**
	1.4	Characterization Report	**$21,206**
2.0		**Cell Cleanout and Isolation**	
	2.1	Remove Small Equipment to A-Cell and Load Into Drums	**$884,664**
	2.2	Remove floor liner, cut up, and load into paint cans	**Not required**
	2.3	Cut utilities (air supply, electrical, process drain, and HVAC)	**$1,984,578**
	2.4	Liquid decontamination processing	**Not required**
	2.5	Seal cell (epoxy, silicon, tape/plastic)	**$128,230**
	2.6	Remove Manipulators and Install Plugs	
	2.7	Cut Cell Anchor Bolts/Concrete	**$103,274**
3.0		**Lift Package Design, Fabrication, Installation & Initial Cell**	
	3.1	Lift Package Design And Fab	**$0**
	3.2	Lift Package Installation, Lift and Final Cell Isolation	**$512,043**
4.0		**Design & Implement Facility Modifications**	
	4.1	East End Building Modifications	**$301,694**
	4.2	Floor Shoring	**$67,500**
5.0		**Heavy Lift**	**$453,516**
	5.1	327 Facility Activities	**$57,984**
	5.2	Transportation and Unloading	**$110,787**
6.0		**Burial Ground Costs**	
	6.1	Burial Ground Costs	**$248,697**
7.0		**Safety and Regulatory Documentation**	
	7.1	Safety Documentation	**$108,955**
	7.2	Transport	**$108,955**
	7.3	Regulatory Process	**$313,314**
8.0		**Project Management**	
	8.1	Project Management	**$3,017,348**
		Total Costs	**$8,646,567**

Cost Assessment Results

The results of this analysis (Table A.3) indicate that the cost of the alternative for intact removal of the cells is estimated to be $8.7M. Given the preliminary nature of this estimate, it is recommended that 30% contingency be assumed until more detailed planning and cost estimating can be completed. On this basis, a cost of $11.3M should be used for planning purposes. This compares favorably with the $14.2M baseline cost, which includes:

- Installation of a liquid waste handling system (LHS)
- Removal of all equipment from the cells
- Cut-up and removal of the cell floor liners
- Removal of the cell manipulators and installation of plugs.

In addition, the current baseline does not include removal of the cells and the LHS.

RISK ASSESSMENT

The risk analysis was carried out to

- Identify the relatively high-risk activities in the current project baseline to determine the extent to which they are addressed by the intact cell removal alternative.
- Identify the high-risk activities in the recommended alternative and the associated level of risk.
- Compare the level of project risk in the baseline and the intact cell removal alternative.

The risks analyzed were uncertain events or situations that can potentially adversely affect the project cost or schedule.

Risk Analysis Approach

The approach taken for the analysis was an adaptation of the risk management approach being implemented by the DOE Office of River Protection. It consists of five steps to identify, analyze, prioritize, manage, and report risk. Since this analysis was a one-time analysis rather than part of an ongoing management system, only the first three steps were performed.

1. Risk Identification – Risk analysis began with a defined set of activities with a logic-based schedule. For each activity, risks were identified, discussed, and assessed using the categories and risk levels defined in Table A.4 with supporting rationale. These inputs were obtained at workshops with subject matter experts.

2. Risk Analysis – The risk ratings for each activity from step 1 were mapped into probability distributions for the cost and/or duration of each activity. The mapping used was based on analysis of DOE historical project performance data with the various levels of risk defined in Table A.4. These probability distributions were then used as the input in Monte Carlo simulations for total project cost and/or scheduled.

3. Risk Prioritization – The activities in the defined baseline were prioritized by their relative contribution to overall cost or schedule risk of the project.

Table A.4. Risk Categories and Levels

Risk Level	Scope Definition	Technology	Interface
5 (high)	Inputs, outputs, tasks, and resources are not identified; approach is not supported by customer/stakeholders.	The technology required to accomplish the planned activity has not been identified or does not exist.	Interfaces have not been identified, interface criteria have not been defined; agreement among interface organizations has not been reached.
4	Inputs, outputs, tasks, and resources are identified in concept; approach may be controversial to customer/stakeholders.	The technology required to accomplish the planned activity is only at the experimental level.	Interfaces have been identified, but interface criteria have not been resolved; agreement among involved organizations is expected, but difficulties are anticipated.
3	Inputs, outputs, tasks, and resources are generally understood and conceptually planned; approach is expected to be acceptable to customer/stakeholders.	The technology required to accomplish the planned activity is in full-scale development and demonstration.	Interfaces have been identified and interface criteria are being reviewed; verbal agreement among involved organizations has been reached or is expected to be reached with minimal problems.
2	Inputs, outputs, tasks, and resources are well understood and plans are being finalized; approach is supported by customer/stakeholders.	The technology required to accomplish the planned activity is fully developed and demonstrated, but not in this particular application.	Interfaces have been defined and detailed interface criteria are being verified; formal agreement among involved organizations has been reached (or no external organizations are involved).
1 (low)	Inputs, outputs, tasks, and resources are well understood and planned; approach is approved by customer/stakeholders.	The technology required to accomplish the planned activity is fully developed and demonstrated in this application.	Interfaces have been completely defined and detailed interface criteria have been verified; formal agreement among involved organizations has been documented (or no external organizations are involved).

Baseline Risk Analysis Results

To keep the analysis focused, only the portion of the current project baseline with activities that actually clean up 327 Building was analyzed. Figure A.3 is a summary-level rollup of the more detailed baseline project schedule. Necessary activities such as management and administration, surveillance and maintenance, safeguards and security, etc., that will be required for both the alternative and the baseline were not included.

A workshop with 327 Building project staff was conducted to obtain the input for the analysis as described in step 1 above. The results from this workshop are summarized in Table A.5.

ID	Name	Duration
1	**Remove Materials from 327 Small Projects**	**522 days**
2	**Legacy Waste Removal**	**522 days**
3	Legacy Materials (Pin Tubes)	238 days
4	327 Waste Bucket Removal	397 days
5	PNNL Legacy Waste (2 Concrete Boxes & 3 Drums)	177 days
6	Metallurgical/Dry Storage Sample Removal	261 days
7	Liquid Waste Handling	375 days
8	**Transition 327 Building**	**1228 days**
9	327 Building Basement	264 days
10	**327 Below Grade Structure**	**843 days**
11	327 Facility, Spent Ion Exchange Column Removal	146 days
12	Dry Storage Deactivation	229 days
13	327 Decontamination Chamber/Transfer and Storage	276 days
14	**327 Canyon Deactivation**	**929 days**
15	**G Cell**	**124 days**
16	G-Cell Deactivation	124 days
17	Procure LLD for G-Cell Waste	40 days
18	Decontamination of Internal Surfaces	25 days
19	Remove G Cell Floor Liner	23 days
20	Package Waste Buckets from G-Cell	41 days
21	Ship LLD's for G-Cell Waste (Clean-up)	47 days
22	H Cell	180 days
23	I Cell	181 days
24	E Cell	239 days
25	D Cell	257 days
26	F Cell	229 days
27	B Cell	230 days
28	C Cell	272 days
29	A Cell	245 days
30	327 Canyon Support Areas	274 days
31	327 Waste Compactor/Truck Load/Canyon Gallery	254 days
32	**Canyon Deactivation (SERF) Cells**	**631 days**
33	SERF Cell Nitrogen Recirculation and Cooling Sys	188 days
34	Special Environmental Radiometallurgy Facility	264 days
35	327 Facility Special Environmental Radiometallurgy	286 days
36	SERF Support Area (Rm 19)	151 days
37	327 Support Areas	336 days
38	327 Waste Streams and Utilities	230 days
39	RPS/RLWS	194 days
40	**Contaminated HVAC Deactivation**	**209 days**
41	Canyon Exhaust	158 days
42	Cell Exhaust	209 days

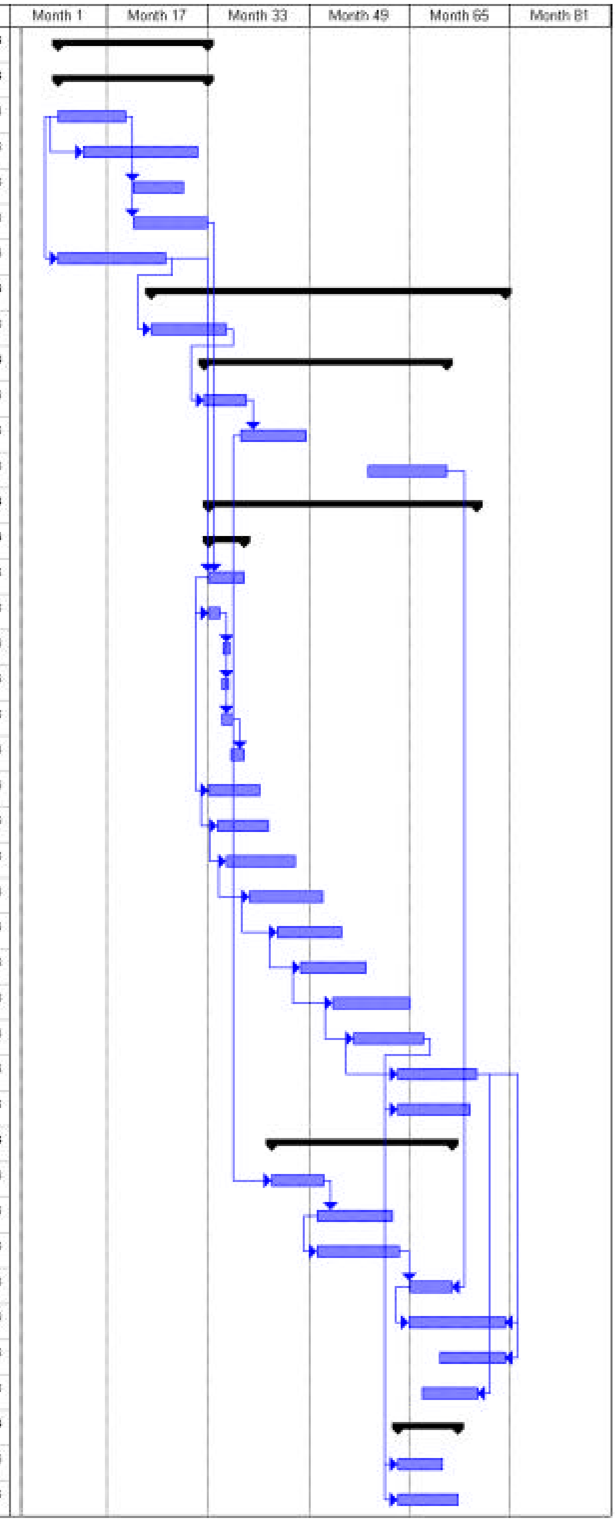


Figure A.3. 327 Building Transition Project Baseline

Table A.5. Baseline Activity Risk Inputs

	Uncertainty Due to Degree of Scope Definition		Uncertainty Due to Degree of Technological Challenges		Uncertainty Due to Degree of Interface Complexity	
Task/Activity Title	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level
PNNL Legacy Waste	2	Waste may require additional sampling to characterize.	2	Technology exists, hasn't been demonstrated in this particular use.	2	Interfaces for disposal, dependent on characterization, disposal should not present a problem.
Metallurgical/Dry Storage Sample Removal	1	Have good understanding of existing waste.	3	Uncertain as to method of removal; new tool may need to be developed to remove waste cans in dry storage.	1	Have previous experience shipping waste, low risk.
Liquid Waste Handling System	4	Baseline plan has known inadequacies, nowhere to ship the liquid waste.	3	Technology to perform work scope exists, not demonstrated on this scale. May require adaptation of technology to integrate, adapt for high rad levels, scale.	5	Disposal capabilities for liquid waste represent a high risk. No agreement with regulators or tank farms exists to accept waste.
327 Building Basement	1	Scope is clear, perform housekeeping activities.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
Spent Ion Exchange Columns	3	Type of packaging required for transportation/disposal of columns is unknown. Remainder of removal scope is routine.	2	Technology exists to perform activity, may require some adaptation for remote operations (i.e., underwater cutting, placing columns in container)	2	Interfaces exist for disposal, waste/package may be non-routine.
Dry Storage Deactivation	2	Scope for this activity assumes not all cans are retrieved from dry storage. Have general understanding of wastes and conditions.	2	Need to develop remote tools, install greenhouse, shielding. Technology exists, may require adaptation.	1	Have experience disposing of waste.
Decontamination Chamber/Transfer and Storage	1	General housekeeping activities, scope is clear.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
Curium Source in Storage	5	Removal of 400Ci Curium source has not been identified in baseline plan. Removal, packaging, and disposal requirements are not identified.	3	Package would need to be developed/modified to handle source.	5	Disposal path for source is unclear, would require high-level interface agreements.
Remove G cell liner	1	Material and removal method are known, low risk.	2	May be some adaptation of existing technology required to remove pieces of liner.	1	Interfaces for this activity are routine.

Table A.5. (Contd)

	Uncertainty Due to Degree of Scope Definition		Uncertainty Due to Degree of Technological Challenges		Uncertainty Due to Degree of Interface Complexity	
Task/Activity Title	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level
Decontamination of Internal Surfaces	1	Scope is known, lots of experience with decon.	2	May require use of new tools to perform work, technology exists.	1	Interfaces for this activity are routine.
Procure LLD, Package Waste, Ship LLDs	1	Routine activity, scope is known.	1	No new technology to be used for this activity.	1	Packaging and shipping of these wastes are routine, interfaces established.
Canyon Support Areas	1	Housekeeping activities similar to basement, scope is low risk.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
Waste Compactor/Truck Load/Canyon	1	Routine	1	Routine	1	Routine
SERF Cell Nitrogen Recircu-lation and Cooling	3	Location and properties of waste is uncertain; similar wastes, but may have higher activity.	2	Cleanup will require remote handling, adaptation of remote equipment may be needed.	2	Interface risk may exist dependent on waste.
Upper SERF	2	Scope defined, assumption made that large 'in-cell' equipment remains in place.	3	Disassembly and size reduction of equipment may require different methods.	3	Interface with regulators/client to validate assumption to leave large equipment in cell.
Lower SERF	1	Scope defined, requires decon, no large equipment.	3	Lack of access ports (only one) may result in technology risk, may require special tools/equipment.	1	Interfaces for this activity are similar to those for other activities, low risk.
SERF Support Area	1	Scope is relatively simple, low risk.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
327 Support Areas	1	Scope is defined, low risk.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
Waste Streams and Utilities	1	Scope is defined, low risk.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
RPS/RLWS	1	Scope is defined, low risk.	2	Potential for some remote operations in high contamination areas could require adaptation of existing technology.	1	Interfaces for this activity are routine.
Canyon Exhaust	1	Scope is defined, low risk.	1	No new technology to be used for this activity.	1	Interfaces for this activity are routine.
Cell Exhaust	2	Scope defined for the most part, condition of system may cause some risk.	3	Filters, valves need to be removed, decon may need to be done. New tools may need to be used to remove parts of exhaust system.	2	Interfaces may exist with packaging of wastes.

With the Table A.5 information as input, cost and duration distributions were created for each activity and Monte Carlo simulations performed. Figure A.4 shows the distribution for total estimated cost (for only those activities in Figure A.3) from the simulation. This analysis indicates that there is about a 10 percent chance of the cost being at or below the estimated baseline cost. A 90 percent certainty, however, can be achieved for a less than 10 percent increase in cost. This suggests that effective risk management would probably achieve the estimated baseline cost.

For the Monte Carlo schedule simulation, some additional logic ties were added to the baseline schedule to logically tie all activities. These logic ties reflect more of the availability of resources than the actual hard logic of the work relationships. Figure A.5 shows the schedule risk for the baseline. While this chart indicates that the baseline schedule is not likely to be achieved, this very low probability of achieving the schedule is substantially an artifact of the logic ties included in the schedule. The cost risk is a more appropriate indicator of the overall project risk.

The final step in the analysis (risk prioritization) was determining which activities are the biggest contributors to project risk. Figures A.6 and A.7 show the relative contributions of activities to cost and schedule risk, respectively. Only the activities contributing the most to risk are shown. The risk contributions of all other activities are relatively insignificant. These results show clearly the activity contributing the most risk is liquid waste handling. Table A.5 indicates that the primary reason for this risk is that the disposition of liquid waste is not known or agreed upon with regulators. Other activities contributing to both cost and schedule risk include cleanup of the SERF, the basement, support areas, and the decontamination chamber transfer and storage.

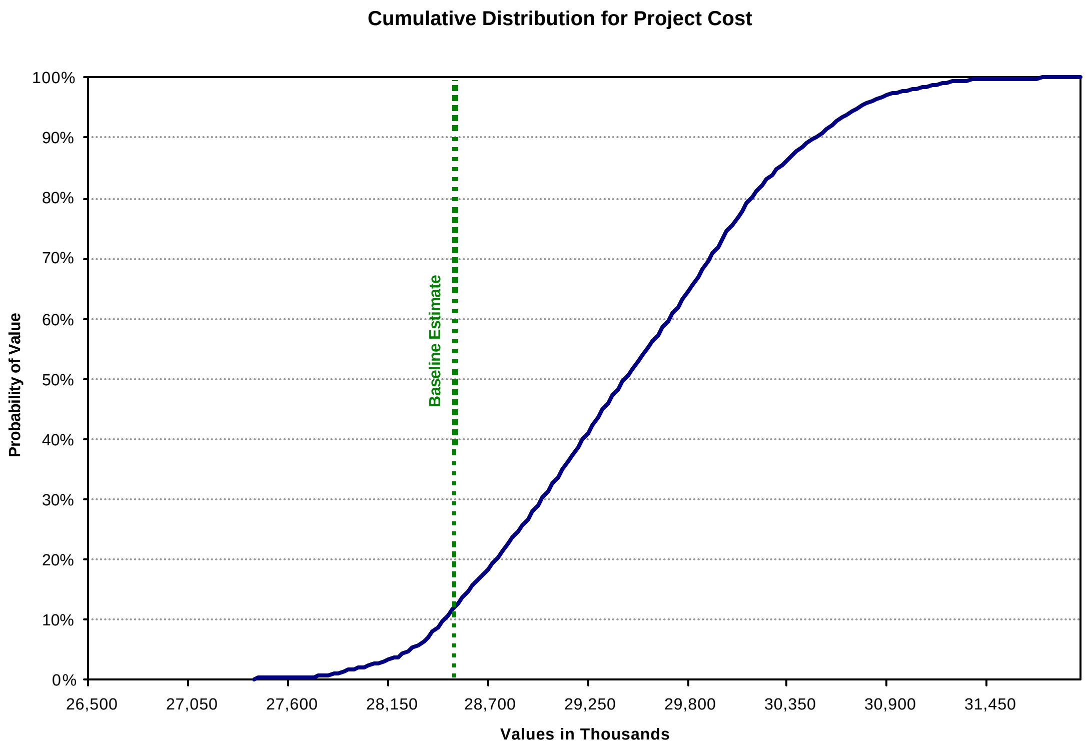


Figure A.4. Cumulative Distribution for the Current Project Baseline Cost

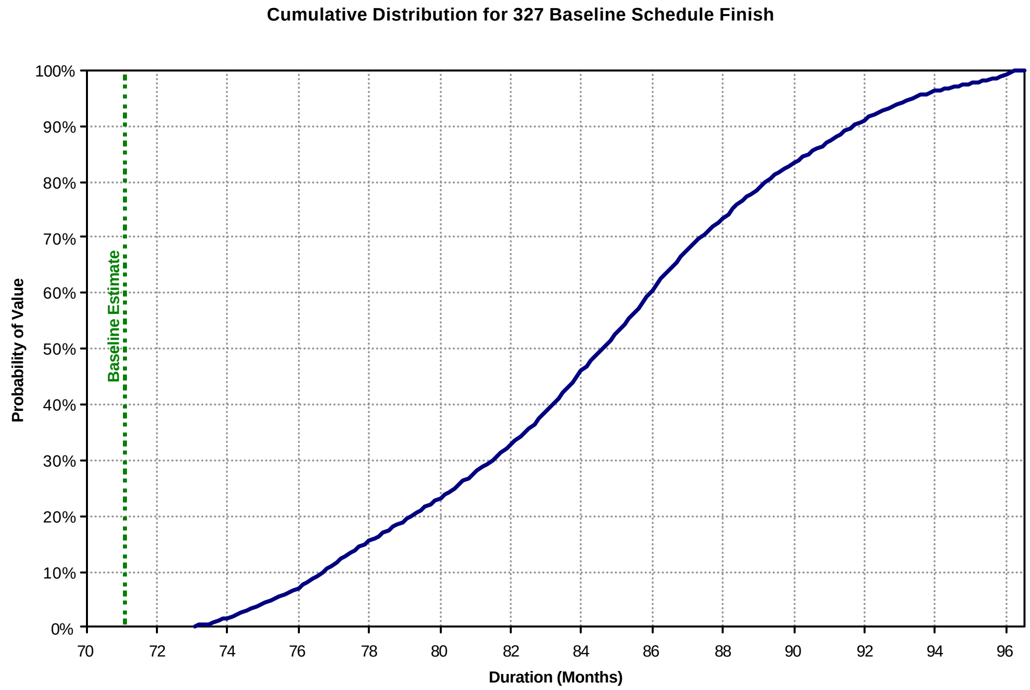


Figure A.5. Cumulative Distribution for Current Project Baseline Schedule Finish

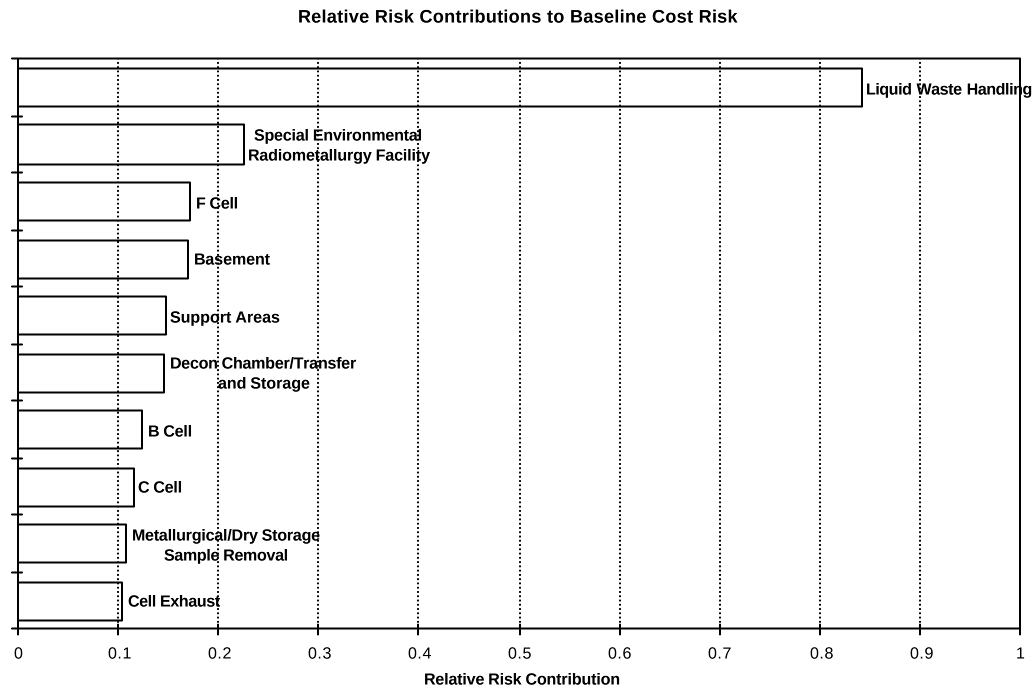


Figure A.6. Relative Risk Contributions to Current Project Baseline Cost Risk

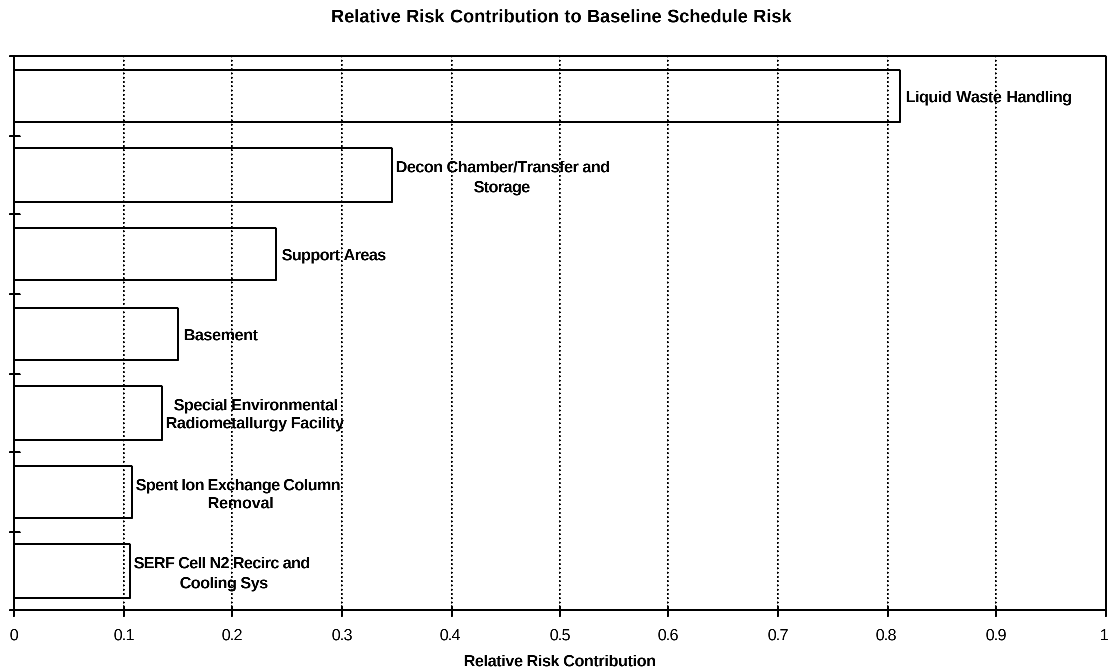


Figure A.7. Relative Risk Contribution to Current Project Baseline Schedule Risk

Recommended Alternative Risk Analysis Results

The risk analysis of the recommended alternative focused specifically on schedule risk analysis. To perform this analysis, the review team created a schedule for the new intact cell removal activities that would be required beyond the current baseline. The determination was made to focus on only the removal of a single cell for the quantitative analysis. G cell was selected because it was considered to be one of the more difficult cells to remove. The risks associated with removal of other cells were described qualitatively to the extent they were considered to be different from G cell. Figure A.8 shows the schedule of activities with logic ties created for the overall approach of removing cells and for the removal of G cell specifically.

A workshop was held to obtain risk input for the intact cell removal alternative from the review team and project staff. This input is summarized in Table A.6. The Monte Carlo simulation was run again using input probability distributions for the duration of each activity derived from the risk level ratings in Table A.6. The schedule risk of completing the defined activities on schedule is shown in Figure A.9. The results suggest the probability of completing this work on or ahead of the defined schedule is about 15 percent. Approximately one and one-half additional months are needed to achieve a high (80–90 percent) level of confidence.

Figure A.10 shows the activities that contribute to this risk. The major contributors are facility modifications, design of facility modifications, revision of the safety basis, DOE approval of the authorization basis, and characterization of the cell. All are required before the cell is removed, so their contributions can be reduced by optimizing the schedule (doing the activities early so they're not on the critical path) and effectively managing their risks (see Table A.6 for specific underlying risks in these activities).

ID	Name	Duration
1	Develop Implementation Plan	44 days
2	Characterize	22 days
3	Inventory Certification	22 days
4	Lift Package Preliminary Design	22 days
5	Lift Package Final Design	44 days
6	Fab Lift Package	66 days
7	Cell Cleanout and Isolation	66 days
8	Design Facility Modifications	110 days
9	Revise Safety Basis	121 days
10	DOE AB Approval	44 days
11	Facility Modifications	110 days
12	Obtain H/L Contractor	66 days
13	H/L Concept	22 days
14	Mobilize H/L Equipment	22 days
15	Install Lift Package	8 days
16	Lift Package	8 days
17	Internal Transport	8 days
18	Load on Trailer	8 days
19	Burial Ground Prep	10 days
20	Transport	5 days
21	Unload at BG	5 days

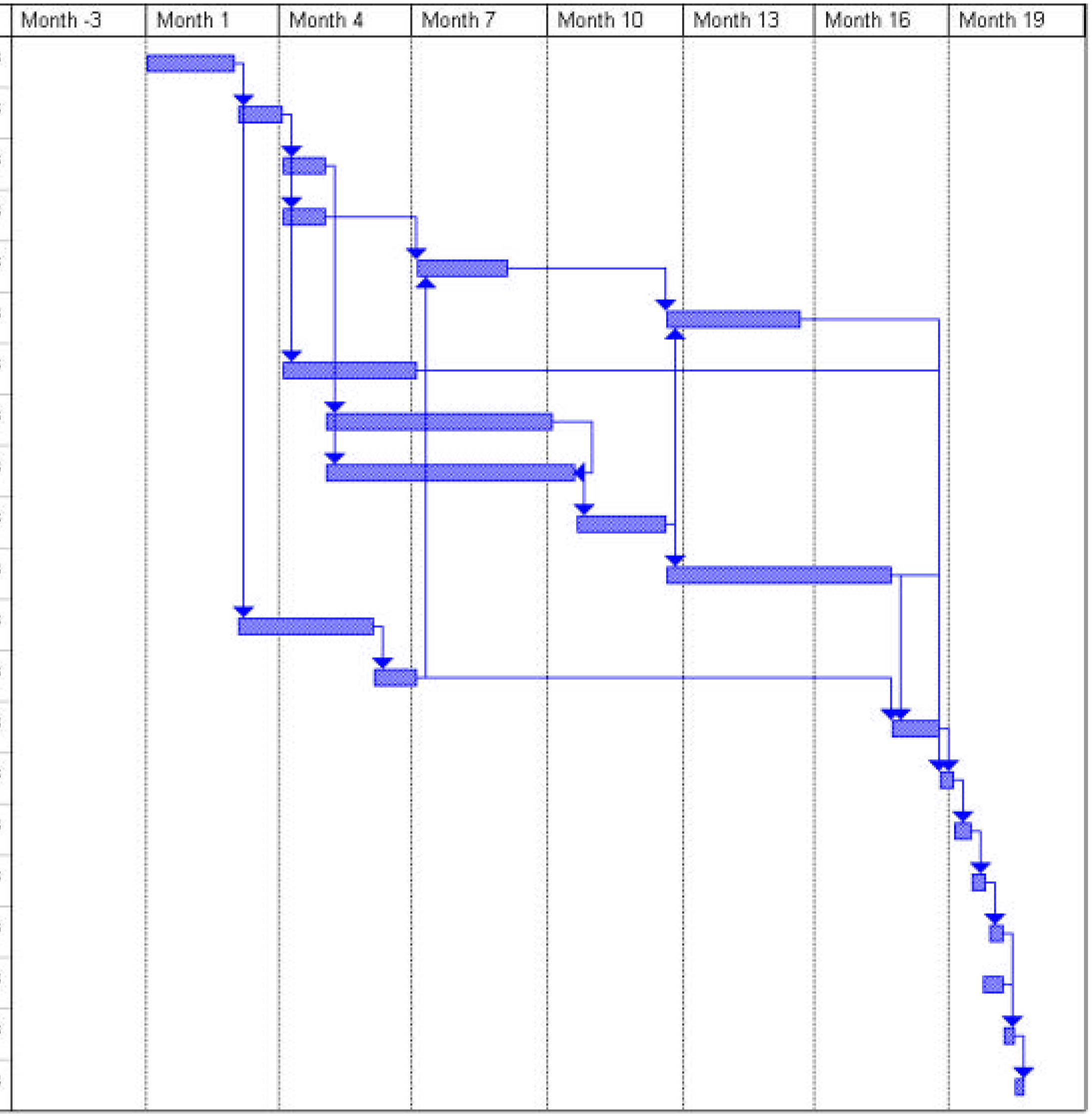


Figure A.8. G Cell Intact Removal Alternate Approach

Table A.6. Alternative Approach Risk Inputs

	Uncertainty Due to Degree of Scope Definition		Uncertainty Due to Degree of Technological Challenges		Uncertainty Due to Degree of Interface Complexity	
Task/Activity Title	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level
Cell Cleanout and Isolation	4	Unclear as to conditions of cell, i.e., are drain lines offset or poured in place; location and number of anchor bolts, cast iron base grouted in place or placed on finished slab. Construction drawings may be inaccurate and unreliable.	2	No new technology will be used; existing technology will need to be adapted to fabricate tool to perform pipe cuts and establish negative dP boundary. Uncertainty is higher in hotter cells.	2	Interface with operations to establish safety and radcon issues.
Characterization (Radiological)	3	Radiological levels are not completely known, hot spots may exist that could change the scope or the level of the work performed.	2	Possibility of the use of new technology for NDA and radio assays, i.e., in-out rather than out-in approach.	1	Interface with lab and operations to perform characterization, routine interaction.
Characterization (Floor Loads)	3	Loads required are uncertain, dependent on transporter, grouting. Rated floor strength may need to be increased or verified at current limit.	1	No new technology would be used to increase floor load limit if needed.	1	No interfaces would be required for this activity.
Inventory Certification	1	This activity relies on the characterization, risk associated in the scope is analyzed in that activity.	1	No new technology would be used for this activity.	2	Regulators may be involved if PCBs or other issues (e.g., lead) were found with the painted surfaces.
Authorization Basis	2	SARP may require revision, modification dependent on radiological levels. Draft BIO is not approved, would need to reflect possible outcomes (e.g., penetration of the building).	1	N/A	3	Interface with DOE to approve the authorization basis. Potential site interface with a “site-wide” transportation SARP being created.
Lift Package Preliminary Design with Final Fabrication	1	Relies on characterization of cell; if structural conditions are known, design and fab of lift package is a low risk activity.	1	No new technology would be used for this activity.	2	Interface would exist with designer and ops.

Table A.6. Alternative Approach Risk Inputs

	Uncertainty Due to Degree of Scope Definition		Uncertainty Due to Degree of Technological Challenges		Uncertainty Due to Degree of Interface Complexity	
Task/Activity Title	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level	Level (1-5)	Rationale for Uncertainty Level
Install Lift Package	2	Field adjustments may need to be made, this for the most part is a planned contingency.	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.
Perform Lift	4	Potential exists that assumptions about penetrations or anchors could be wrong and cell can't be lifted. Decon may be required after lift is performed	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.
Internal Transporter/ Trailer	1	Scope is defined for this activity, low risk.	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.
Obtain Heavy Lift Contractor	3	Heavy lift contractor may not have suitable transporter to perform job, may result in increased costs and schedule.	2	Adaptation of technology may be required for the transporter.	3	Interface with contract personnel and heavy lift contractor. Contract process may be delayed or contractor may not exist.
Mobilize Heavy Lift Equipment	1	Scope is defined for this activity, low risk.	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.
Burial Ground Prep	1	Scope will be determined in the authorization basis.	1	Existing technology will be used to dispose of cells.	3	Interface with EPA, Dept. of Ecology, and the disposal facility to determine where to send waste and requirements.
Transport	1	Scope is defined for this activity, low risk.	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.
Unload	1	Scope is defined for this activity, low risk.	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.
Shoring/Site Prep	1	Scope is defined for this activity, low risk.	1	No new technology would be used for this activity.	1	Interfaces required for this activity are routine.

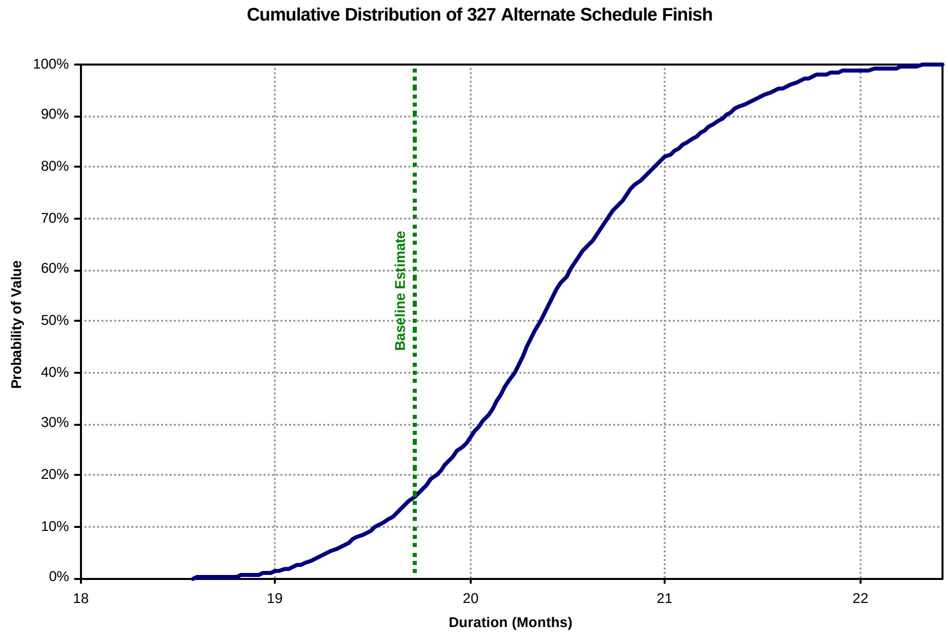


Figure A.9. Cumulative Distribution of 327 Alternative Schedule Finish

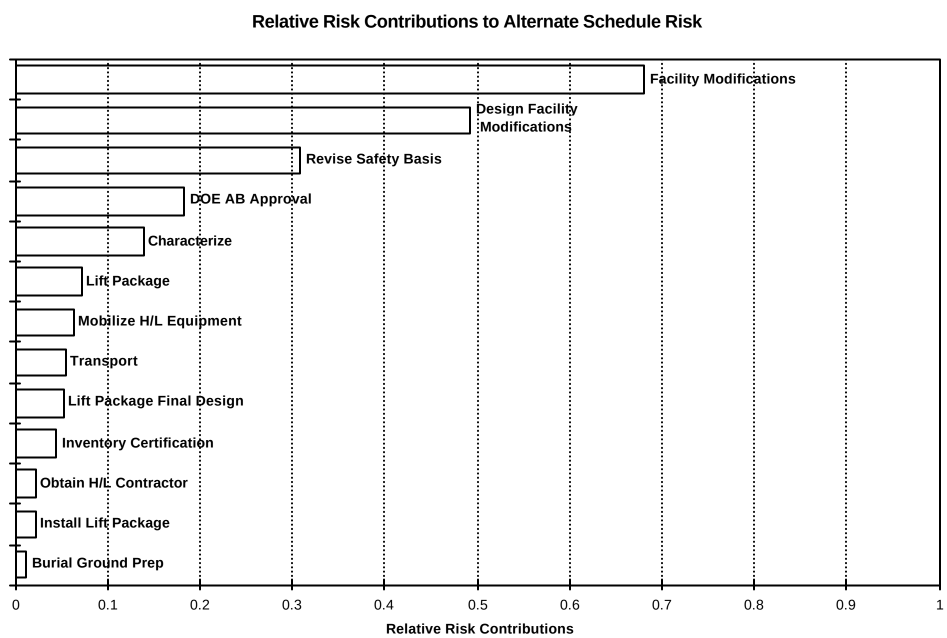


Figure A.10. Relative Risk Contributions to Alternative Schedule Risk

Comparison of Baseline and Recommended Alternative Risks

To provide some additional direct comparison between the baseline and the alternative, the activities in the alternative that actually physically remove the cell, i.e., activities 7 and 14–21 on Figure A.8, were substituted for the G cell deactivation activities in the baseline, i.e., activities 16–21 in Figure A.3. (This analysis assumes that the other activities required for the alternative approach can be completed along with the other baseline activities planned prior to actual work on G cell.)

The results for the schedule risk analysis of the two approaches are shown in Figure A.11. Only the duration of the actual G cell work is shown for both the baseline and for the recommended alternative. This figure shows that the estimated duration for the alternative is slightly less than that for the baseline (21.5 versus 24 weeks) and that the risk is lower (probability of completion is higher) for the alternative through about 24 weeks. The alternative has a higher probability of stretching to a few extra weeks, however, because of the relatively high risk of the cell cleanout and isolation activity due to uncertainty about the condition of the cell (see Table A.6.)

This comparison establishes that the expected durations of both approaches are not substantially different, nor are the risks in their respective schedules. This lack of difference should be considered in the context of the substantially greater achievement of the intact cell removal in comparison to the baseline, which achieves only deactivation with ultimate removal some time in the future.

Conclusions

Several conclusions regarding the recommended alternative can be drawn from these risk analyses:

1. While cell deactivation is not the major source of risk to the project, it is a significant contributor (see Figure A.6), and thus changes in the baseline for deactivation of cells can potentially reduce project risk.

2. The largest contributors to risk in the recommended alternative are activities that precede any actual cell removal. Appropriate planning and schedule optimization can be expected to reduce the risk of these activities.

3. With effective planning, the risk of the actual cell removal activities is quite low.

4. Implementing the recommended alternative does not increase project risk and achieves a more desirable end state.

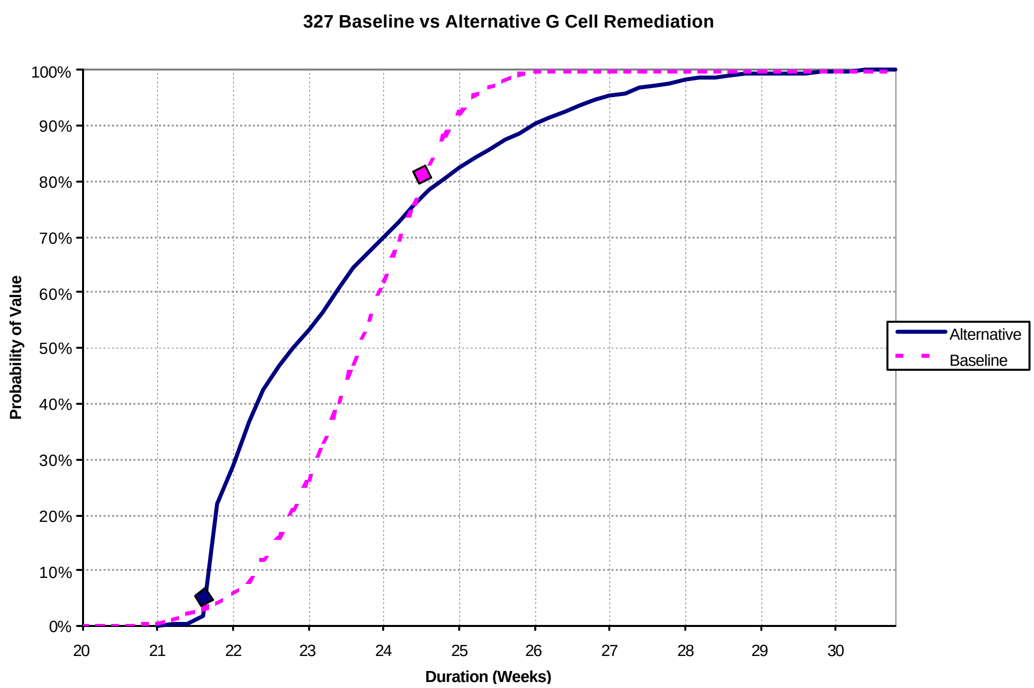


Figure A.11. 327 Building Baseline Versus Alternative G Cell Remediation Schedule Risk

The risk analysis for the alternative is based on several assumptions. For the most part, these assumptions will be validated by closure of the issues identified in Section 7 of this report. These assumptions are that:

- Waste is determined to be non-TRU
- Funding and manpower are not constrained
- Heavy lift and transport equipment exists without custom design or fabrication
- There are no regulatory constraints to schedule
- There are no safety class or NQA-1 requirements
- Lead time for the heavy lift contractor is adequate
- The draft BIO will allow for cell removal as a design feature through the east wall of the building.

As noted elsewhere in this report, these assumptions are believed by the review team to be reasonable. But they do emphasize the need for high quality data and analysis in characterization (both physical and contaminant inventory), and the revision of the draft BIO to allow cell removal with relatively quick approval by DOE to manage the risk of this alternative.

Enclosures

Information provided in this Enclosure provides backup and supplemental detail information prepared during the development of the cost analysis. A cost estimate resource summary is provided in Table A.7. Enclosure designations refer to the applicable WBS cost element provided in Table A.3 as listed below:

WBS	
1.1	Characterization plan
2.7	Cutting cell floor anchors
4.1	East end building modifications
5.1, 5.2, 3.1 and 3.2	Heavy lift transport
5.2	Crane off-loading
6.0	Hot cell burial costs
7.3	Back up to regulatory process
Table A.7	Templates taken from the current baseline and used in the cost estimate

Table A.7. Cost Estimate Resource Summary

WBS Element	WBS Sub-Task	Title	Total Cost	Safety Eng	Health Physicist	Engineering Support	Rad Con Tech	Operator	Supervisor	Manager	Materials ($K)	Contract ($K)	Other ($K)	PMP Rev 3 Template Costs (Fully Burdended)	Comments/ Notes
1.0		**Characterization & Inventory Certification**													
	1.1	Characterization Plan	$60,376	$6,000	$8,182	$36,000				$3,716		$6,479			Contract LMSI for Docment Support
	1.2	Obtain Samples	$98,658				$10,072	$40,760	$5,788		$9,718			$32,320	2 HCT/.5 RCT/.25 Sup 1 week per Cell, Need 1 complex TWP(P06)/RWP(P02) per Cell based on Templates
	1.3	Sample Analysis	$64,788										$64,788		5K per Cell for Sample Analysis costs
	1.4	Characterization Report	$21,206		$2,727	$12,000						$6,479			Contract LMSI for Docment Support
2.0		**Cell Cleanout and Isolation**													
	2.1	Remove Small Equipment to A-Cell and Load Into Drums	$884,664											$884,664	Some Waste Removal will be required to support cell removal, assume 20% of approved baseline estimate
	2.2	Remove floor liner, cut up, and load into paint cans	Not required												access below the floor liner will be required and this is covered in WBS section 1.2
	2.3	Cut utilities (air supply, electrical, process drain, and HVAC)	$1,984,578											$1,984,578	Cost Estimate based on PMP Rev 3 costs
	2.4	Liquid decontamination processing	Not required												
	2.5	Seal cell (epoxy, silicon, tape/plastic)	$128,230											$128,230	Cost Estimate based on PMP Rev 3 costs
	2.6	Remove Manipulators and Install Plugs													
	2.7	Cut Cell Anchor Bolts/Concrete	$103,274				$6,446	$13,043	$7,409			$44,056		$32,320	4 HCT/2RCT/2 Sup for 8 days, Need 1 complex TWP(P06)/RWP(P02) per Cell based on Templates
3.0		**Lift Package Design, Fabrication, Installation & Initial Cell Lifting**													
	3.1	Lift Package Design And Fab	$0												
	3.2	Lift Package Installation, Lift and Final Cell Isolation	$512,043				$42,302	$114,128	$32,413					$323,200	7 days per cell, 4 HCT/1.5 RCT/1 Sup, Need 1 complex TWP(P06)/RWP(P02) per Cell based on Templates
4.0		**Design & Implement Facility Modifications**													
	4.1	East End Building Modifications	$301,694			$9,000						$228,054		$64,640	Need 2 complex TWP(P06)/RWP(P02) based on Templates
	4.2	Floor Shoring	$67,500			$67,500									Cost of study, assume no shoring required
5.0		**Heavy Lift**	$453,516									$453,516			Contract costs for Heavy Lift Contractor covers workscope in WBS 3.1, 3.2, 5.1 & 5.2
	5.1	327 Facility Activities	$57,984				$16,115	$32,608	$9,261						2 days per cell, 4 HCT/2 RCT/1 Sup, TWP/RWP part of WBS 3.2
	5.2	Transportation and Unloading	$110,787										$110,787		$85.5K for Crane and Rigging Support, transportation covered in Heavy Lift Contract
6.0		**Burial Ground Costs**													
	6.1	Burial Ground Costs	$248,697				$16,115	$32,608	$1,852		$64,788		$133,334		Assume LLBG costs @ $52.9K and $50K for Grouting
7.0		**Safety and Regulatory Documentation**													
	7.1	Safety Documentation	$108,955											$108,955	PMP Template P10, split between WBS 7.1 and 7.2
	7.2	Transport	$108,955											$108,955	PMP Template P10, split between WBS 7.1 and 7.3
	7.3	Regulatory Process	$313,314			$268,350				$44,964					Assume 80% resources used in 1st year
8.0		**Project Management**													
	8.1	Project Management	$3,017,348											$3,017,348	Combined PM/Maintenance estimated Cost from PMP Rev 3
		Total Costs	$8,648,567												

Enclosure 8-1.1

Cost Estimate Basis Backup for WBS 1.1

- Removal Action Work Plan
- Develop Data Quality Objectives to support requirements to meet disposal criteria
- Develop Sample and Analysis Plan

Duration three months
(Two months to draft document, one month to review and approve)

One engineer @ 480 hours
One health physicist @ 120 hours
One laboratory scientist @ 120 hours
One safety specialist @ 80 hours
One project manager @ 40 hours
Document Control/ECN issuance = $5,000

- Obtain Samples

Duration one week per cell (10-week duration)—can be performed in parallel
One day to prep cell for sampling, two days for sampling, one day to seal out samples and package samples, one day to transport to the lab
Assume 12 samples per cell (two samples per cell face)
Assume samples composited to one sample for analysis for each cell
Assume lab can handle shielded containers and samples
Assume shielded transport container is available for sample transport
Assume manipulator/tools are available for use in obtaining samples

Two operators @ 40 hours each
One RCT @ 20 hours
One Supervisor @ 10 hours
Total cost per cell = $5,800
Estimated sample container costs and transportation $7,500

- Sample Analysis

Duration two weeks
Assume samples composited to one sample for analysis
Assume $5K per composite sample for radiological and chemical analysis
Total sample analysis cost 10 samples @ $5,000

- Characterization Report

Duration one month
Individual cell package work plans to support waste designation
One engineer, 160 hours
Technical review support, 40 hours
Document control/ECN issuance = $5,000

Enclosure 8-2.7

Cost Estimate Basis Backup for WBS 2.7

- Estimate for cutting cell anchors to floor

Pedestal Mounted Cells—A,F,G,H
Each cell anchored to floor with a 1-1/2-in. anchor bolt in each corner. A horizontal cut using a concrete saw selected. Budget estimate from Will at Pro-Cut, Kennewick, 582-4064.

- Concrete saw cutting flush with floor, wet cut with vacuum pick-up.
- 1 ½ hours per corner cut, 16 corners, 20 hours total. Assume three days, 24 hours
- Two man crew, $105/hr total = $2520
- Six hours travel time @ $40/hr = $240
- Equipment/materials = $700
- Subtotal $3460, round up to $4000

- SERF Cell

Two cuts through 15x8 ft concrete pedestal using a concrete wire saw. Budget estimate also from Pro-Cut; however, they stated larger companies would most likely beat their material costs by a factor of 2 because they make their own diamond wire saws. Assumption that concrete pedestal is not steel lined.

- Three men, two shifts/cut. With setup and cleanup assume five shifts.
- Crew cost $150/hr total = $6000
- Equipment/material (diamond saw wear) $12,000/cut = $24,000
- Subtotal = $30,000

Total cutting contract cost $34,000

Enclosure 8-4.1

Cost Estimate Basis Backup for WBS 4.1

- East End Building Modifications

A Butler type building would be added to the east end as a temporary air lock to be used to transload the hot cells from the in-building transporter to the over-the-road transporter.

This estimate scopes the Butler building as follows:

- 30x50 ft footprint, 30 ft high
- Free standing with weather seal attachment to existing building
- Two roll-up doors, 20x20 ft, one at each end
- Two personnel access doors
- R-11 insulation, no heating system required
- Foundations and slab floor
- Turnkey design and installation

Budget cost estimate for above of $101,000 from Shamrock Contractors (see attached FAX)

An allowance of an additional $75,000 for the following modifications required to make this completely serviceable:

- Opening in 327 east end wall
- Electrical service and lighting in Butler building
- Concrete ramp providing transloading capabilities
- Integration of basement exit stairs with building foundation

Total estimated cost $176,000[a]

(a) Possible alternative: If only a temporary door in the east end wall would be required (justified from a safety standpoint) a budget cost of $50,000 could be used.

SHAMROCK CONSTRUCTORS INC.
WASH LIC. #SHAMRCI169RM • OR. LIC. 128467
2407 North Commercial Ave., Suite A
Pasco, WA 99301

(509) 542-0097
fax: (509) 547-5919

April 11, 2001

Mr. Don Ball
Vista Engineering
Richland, WA 99352

Re: **Preliminary building quote**

Dear Don:

Per our telephone conversation, Shamrock Constructors is pleased to present the following preliminary proposal constructing a building in the 300 Area in Richland, Washington.

Our proposal includes the following:

- Supply and erection of a 30' x 50' x 30', Butler pre-engineered building with MR-24 standing seam roof panel and Butlerib II wall panels.
- Roof and wall are insulated with an R-11, 3" insulation system.
- Two (2) 20' x 20' overhead doors, with electric operators and two (2) 3' x 7' personnel doors.
- Engineered foundation with an 8" thick floor slab.
- An allowance has been made for foundation design and basic architectural drawings.

Our preliminary quote as described above is in the amount of **$ 101,000.00**, excluding sales tax.

If you have any questions, please do not hesitate calling me at (509) 542-0097.

Respectfully submitted,

Kevin Harrington

Kevin Harrington
Vice President

C:vistaengprelimprc.doc

BUTLER
BUILDER

Enclosure 8-5.1

Cost Estimate Basis Backup: all of 5.1, transport portion of 5.2 and all of 3.1 and installation portion of 3.2

- Background information provided to Lampson International, Ltd.

1. Scope

Planning type estimate to support an Engineering Study
10 cells in total per attached description
Design and fabricate lift structures—fixed price
Supervise installation of lift structures and first lift—cost plus
Final lift, removal from building, transport to 200 Area Burial Grounds—fixed price

2. Basis and Assumptions

Cell construction per attached description and photo
Building layout per attached sketch—cells removed in sequence starting with I cell and ending with SERF cell
Floor loading per attached description—discussion required as to requirement for shoring
External room for transporter per attached drawing—assume a suitable route out of the 300 Area is made available
Access to cell floor level from outside provided, along with air lock building
All cell preparation work leading up to installation of lift structure and final isolation of the cell is not in scope of this estimate

3. Design/Fabricate Cell Lift Structure—Fixed Price

Cell size/weight

Cell	Estimated cell weight (tons)	Estimated cell weight filled with grout (tons)	Estimated nCi/g based on 15 g Pu^{239} and grouted cell weight(1)	Grams of ^{241}Am required to be designated as TRU waste	Size, ft(2)	Wall Thickness, in.
A	155	180	7	4.8	9.5x4.5x8.17	18
B	60	70	19	1.9	6x4.3x4.3	15
C	40	450	29	1.2	6x4.3x4.3	10.5
D	40	45	29	1.2	6x4.3x4.3	10.5
E	40	45	29	1.2	6x4.3x4.3	10.5
F	145	170	8	4.5	8x5x8.17	18
G	95	135	10	3.6	10.25x6.25x8.3	10.5
H	50	60	22	1.6	5.3x4.6x7.1	10.5
I	35	40	33	1.1	4.3x4x5.17	10.5
Upper SERF	160	196	7	5.2	12x5x5	15-18

(1) Simple volume and weight calculation, cast iron density = 442 lb/ft^3.
(2) Interior dimensions; last dimension is height (Landsman et al. 1998).

Cell Construction

Cell assemblies A, F, G, and H are of similar construction and consist of a number of rectangular cast iron blocks that form the sides, top, and bottom of the cells. Cell A is typical. It consists of

- Front–2 pieces, left and right
- Rear–6 pieces, upper, lower, left, right, and center (consists of 2 pieces)
- Left/right sides–2 pieces each, upper and lower
- Bottom–2 pieces
- Top–2 pieces.

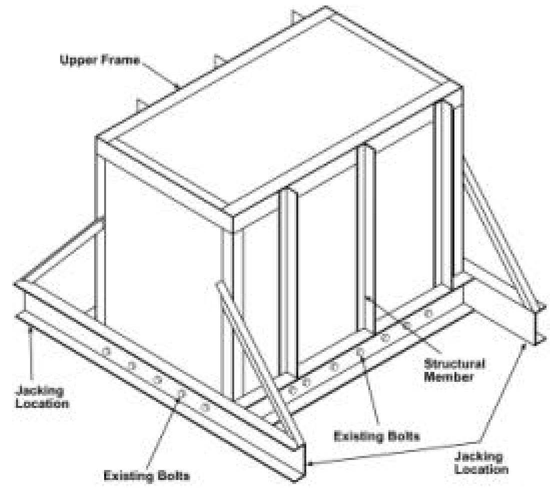
The front, rear, and side blocks form the walls and nestle around the base. They are held together at the corners with 1½-inch bolts in tapped holes. They are attached to the base with a number of horizontal 1½-inch bolts that are secured in tapped holes in the cell base. The base is anchored to the floor with 1½-inch anchor bolts that are located approximately 12 in. from the edge of the base. The blocks that form the upper portion of the walls are placed on the lower side and end blocks and held in position by alignment pins at the upper/lower block interface. These blocks are also bolted together at the corner edges. The upper SERF cell is of similar construction with the exception that armor plate is used instead of cast iron.

Cell assemblies B, C, D, E, and I are also constructed of a number of rectangular blocks that form the sides, tops, and bottoms of the cells. These cells are similar in concept to cells A, F, G, and H except that they are smaller and are raised above the floor on structural steel posts.

The front, rear, and side blocks nestle around the base and are held together with 1½-inch bolts in tapped holes. As with cell assemblies A, F, G, and H, the walls are attached to the base with a number of horizontal 1 ½-inch bolts in tapped holes. The vertical posts that support the cell are attached to the floor with concrete anchor bolts.

Lift Concept

The concept for lifting the floor-mounted cells will be to encase the cell in an external framework of structural steel members that "capture" the cell as a unit and prevent the cast iron blocks from shifting or coming loose as the unit is lifted and moved (see figure below; Figure 4.2 in the main report). The major horizontal structural steel members around the lower portion of the cell unit will provide locations for jacking within the building and for lifting the unit later as needed. After the cell is released from its anchorage and lifted off the floor, a pallet or strongback will be placed underneath. This pallet will be attached to the other added external structure to provide the final lift package. The locations of the bolts that attach the cells to the base will be used to provide the structural tie between the cell and the exterior frame so that the unit can be lifted and the pallet placed underneath.



Hot Cell Package Concept (pedestal mounted)

The next step in preparing the lift package will be to remove the sidewall bolts that thread into the cell base. Also, any small components that are mounted on the outside of the cell near the base should be removed for disposal. After the bolts are removed, a horizontal frame made up of structural members will be placed around the base. This frame should fit snugly around all four sides of the cell. The frame will be attached to the cell using the existing tapped and threaded bolt locations in the cell sidewall and base, as noted above. New, longer bolts will be used to achieve a higher shear-strength material and provide sufficient thread engagement. The frame will have extended outriggers in the north-south direction to use later as jacking locations.

Additional steel structural framework will be added to the top of the cell and to the vertical corners to stabilize the cell wall and keep the top blocks from moving. Finally, the upper and lower frames will be joined together with additional members to keep the individual blocks from shifting while the cell is being handled. The cell is now ready to be lifted from its attachment to the floor.

Install Lift Package/Supervise Lift—Cost plus

- Provide supervision to site forces to install each lift package and initial lift to permit clean-up/isolation of bottom surface.
- Provide necessary jacking equipment and structures to support cells during clean-up/isolation

Final Lift/Removal from Building/Transport to 200 Area Burial Grounds—Fixed Price

- All hot cells would be prepared for this step before initiation so that once the effort is started in can run to completion without interruption. Also, some of the lighter hot cells could be transported together to the burial grounds.
- Current floor loading capability is 20 tons on a 3x3 foot area or 350 lb/ft^2 uniform load on a 16x16 foot area. These values may be increased through additional calculation.
- Heavy lift contractor to be responsible for all lifting, removal from the building, and transportation to the burial grounds.

Unloading Support at Burial Grounds

TBD

- Text from letter from Lampson International, Ltd.

April 16, 2001

Don Ball
Consulting Engineer
Vista Engineering Technologies, L.L.C.
3000 George Washington Way, Suite 2C
Richland, WA 99352
Fax 375-5204

Dear Mr. Ball:

In regard to your inquiry as to the lifting, transportation, and unloading of 10 hot cells located in the 300 Area.
Lampson would like to propose a Jacking Gantry System on rails. This would require lifting frames that could be top lifted. Suitable cribbing would be utilized to reduce load bearing. A tractor and trailer of appropriate size would be used to make seven trips to the ERDF site. A total estimated cost for lifting, transportation, engineering and fabricating of frames would be approximately $350,000.00.

If you should have any questions, please do not hesitate to contact us.

Very truly yours,

Rusty Rutherford
Equipment Manager

RR:lw

Enclosure 8-5.2

Cost Estimate Basis Backup for WBS 5.2

- Crane off loading estimate:

Normal crane crew consists of driver, main crane operator/crew chief, assistant operator, and two riggers @ $81.00 per hour
Crane rental is $600 per day
Assume 240-ton capacity Manitowoc crane is available in the LLBG
Assume one day to set up crane, two days per cell to complete the lift and place the cell in the trench, and one day to demobilize the crane

Total estimated time 22 days crane rental
22 days @ 5 FTE @ 8 hrs/day @ $81/hr

Enclosure 8-6.0

Cost Estimate Basis Backup for WBS 6.0

- Burial Costs:

Estimated Volume:

Cell	Volume – ft^3	Weight-tons
A	450	155
B	150	60
C	150	40
D	150	40
E	150	40
F	360	145
G	693	95
H	240	50
I	120	35
Upper SERF	300	160

Total estimated volume = 2763 ft^3 or roughly 3,000 ft^3
LLBG LLW Burial base rate = $17.64 per ft^3 or 3,000 ft^3 x $17.64 = $52,900
Total estimated tonnage = 820 tons
ERDF LLW disposal rate = $31.08 per ton or 820 tons x $31.08 = $25,490

Conclusion: Disposal at ERDF is roughly half the cost of disposal at the LLBG

- Grout Costs

Rough order of magnitude grout costs provided by Steve Phillips, AGEC (Advanced Geotechnical Engineering and Construction). Estimated cost $5K per cell average.
Assumptions:

- Small cells can be filled with grout in one campaign.
- Large cells will require two campaigns each due to dissipation of heat generated during grout cure.
- Total estimated cost for 10 cells = $50,000

-
- Operations support for Grouting

Assumptions:

- Grout operation is assumed to take three days for single pour cells and five days for double pour cells. One day for setup, one day or three days for grout pour and one day for demobilization.
- Total duration is five cells @ single pour rate + five cells @ double pour rate. three days * five cells + five days * five cells = 40 days or 8 weeks duration.
- Two operators @ 40 days * 8 hr/day * $51.36 per hour = $32,870
- One RCT @ 40 days * 8 hr/day * $54.03 per hour = $17,290
- One supervisor @ 40 days * 8 hr/day * 10% * $64.00 per hour = $2,050

Total operations support = $52,210

- NOC (Grouting)

Operation requires an NOC that covers all 10 cells. Estimated cost is $2K and three week duration.

Enclosure 8-7.3

Cost Estimate Basis Backup for WBS 7.3

		Mgr	Engrg	% mgr
Engineering Evaluation/Cost Analysis		96.0	1200.0	10%
Removal Action Work Plan (including DQO and Sampling and Analysis Plan)		**Included in WBS 1.1**		
Health and Safety Plan (if 327 not already covered by an existing H&S Plan).		32.0	400.0	10%
Administrative paperwork (MOU, Contract) for FH staff to work with BHI staff		100.0	138.9	50%
Reimbursement to BHI for their staff's time in working MOU/Contract and reviewing DQO/SAP.		40.0	500.0	10%
Public Involvement and Administrative Record costs.		60.0	83.3	50%
General support to RL and EPA regarding regulatory issues and preparation of Action Memo.		40.0	55.6	50%
Contingency costs.		32.0	400.0	10%
Total Hours =	**3178**	**400**	**2778**	

Enclosure 8-Table A.7

Cost Estimate Basis Backup for Table A.7

- P02

Template	Radiological Work Permit (Complex)			Other Engineers	Managers & Executives	First Line Supervisor	Health Physicists	Hot Cell Technicians	Health Physics Technicians	
	Template Code:	P02								
	Basis of Template:	1	Complex RWP							
P02	Activities			BE13E	BM02E	BM01E	BP08E	BR05B	BT05B	Responsibilities
	Radiological Work Permit (Complex)									
	Develop RWP			4					6	RCT write RWP (6 hr/RWP), Engineer provide technical insight (4 hrs/RWP)
	Perform ALARA review			4			6			Health physicist perform ALARA review (6 hrs/RWP), engineer support (4 hrs/RWP)
	Prepare dose estimates			4			16			Health physicist perform dose estimates (16 hrs/pkg), Engineer assist/provide tech basis (4 hrs/pkg)
	Perform walkdowns			2				4	2	2 hour walkdown consists of 1 engineer, 2 HCTs, 1 RCT
	Review package and attend ALARA review meetings			4		4	4	4	4	Review 4 hrs/pkg each
	Prepare/present package for ALARA committee			6				2	2	Eng prepare package (6 hrs/pkg), RCT & HCT input/assist (2 hrs/pkg each)
	Perform enhanced ALARA review			6	6	6	6	6	6	Review 6 hrs/pkg each
	Obtain approvals/signatures			5	1	1	1	1	1	Engineer obtain signatures, meet individually with each approver to discuss/sign off
	Total labor hours/non-labor dollars (per RWP)			35	7	11	33	17	21	

-BUSINESS SENSITIVE-

- P06

Template	Technical Work Plan/Procedure (Complex)																			
	Template Code:	P06																		
	Basis of Template:	1	Complex TWP/Proc																	
				Other Engineers	AJHA Coordinator	Quality Control Engineers	Safety Engineers	Environmental Engineers	First Line Supervisors	Managers & Executives	Technical Writers & Editors	Health Physicists	Hot Cell Technicians	Health Physics Technicians	Electricians	Millwrights	Plumbers & Pipefitters	Other Craft	Planner/Scheduler/ Estimator	
P06	Activities			BE13E	BE10E	BE11E	BE12E	BE05E	BM01E	BM02E	BP16E	BP08E	BR05B	BT05B	BC02B	BC06B	BC08B	BC12B	BP07E	Responsibilities
	Technical Work Plan/Procedure (Complex)																			
	Outline TWP/procedure			32		8	8	8	32		100	8	8	8						Tech writer draft outline (100 hrs), 2 engineers and 2 sups technical input (16 hrs each), input from QC, safety, env, HP, HCT, RCT (8 hrs each)
	Walkdown TWP/procedure outline			4					8		4	4	8	8						Walkdown team consists of eng, 2 sups, HP, 2 HCTs, 2 RCTs, tech writer (4 hrs each)
	Perform ISMS/AJHA preparation and meeting			8	8	8	8	8	8	8	8	8	8	8	8	8	2	4		Participate in 8 hr AJHA meeting
	Prepare/issue draft TWP/procedure and participate in initial meetings			32		6	6	6	32		120	6	12	12						Tech writer draft plan (120 hrs), 2 engineers and 2 sups technical input (16 hrs each), input from QC, safety, env, HP, 2 HCT, 2 RCT (6 hrs each)
	Review/comment on draft TWP/procedure			16		8	8	8	16	8		8	16	16						Review 2 eng, 2 sups, QC, safety, env, HP, 2 HCT, 2 RCT, mgr (8 hrs/plan each)
	Participate in review meeting			12		6	6	6	12	6	10	6	12	12						Review meeting 2 eng, 2 sups, QC, safety, env, HP, 2 HCT, 2 RCT, mgr (6 hrs/plan each), Tech writer prep & conduct meeting (10 hrs)
	Incorporate comments/distribute/review			8		2	2	2	8	2	48	2	8	2						Tech writer revise/distrib plan (48 hrs), 2 eng, 2 sups, 2 HCTs input/review (4 hrs each), QC, safety, HP, RCT review (2 hrs/plan each)
	Mockup/walkdown TWP			8		2	2		40	4		2	120	40	4	4		4	2	
	Participate in final review meeting			4		2	2	2	4	2	6	2	4	4						Final review meeting 2 eng, 2 sups, QC, safety, env, HP, 2 HCT, 2 RCT, mgr (2 hrs/plan each)
	Incorporate comments and finalize TWP/procedure			8		2	2	2	8		24	2	8	2						Tech writer finalize plan (24 hrs), 2 eng, 2 sup, 2 HCT technical input/clarification (4 hrs each), QC, safety, HP, RCT input/clarification (2 hrs each)
	Approve/issue/release TWP/procedure			2		2	2	2	4	2	16	2		2						Tech writer obtain signatures, meet individually with each approver to discuss/sign off
	Total labor hours/non-labor dollars (per TWP/Procedure)			134	8	46	46	44	172	32	336	60	204	114	12	12	[illegible]	[illegible]	2	

- P10

	Safety Analysis Report for Packaging (P10)											
	Number of SARP packages to be completed:	**1**										
Template												
P10												
			Secretary	**Plant Engineers**	**Quality Control Engineers**	**Managers & Executives**	**Health Physicists**	**Mechanical Engineers**	**Safety Engineers**	**Environmental Engineers**	**Technical Writers & Editors**	**Nuclear Engineer**
			19300	**19300**	**19300**	**19300**	**19300**	**19300**	**19300**	**19300**	**19300**	**19300**
			BG04N	**BE10E**	**BE11E**	**BM02E**	**BP08E**	**BE07E**	**BE12E**	**BE05E**	**BP16E**	**BE08E**
	Develop packaging Design											
	Initiate the design process (Plant Engineer 10 hrs/package)			10								
	Develop preliminary packaging design, this includes the preliminary safety assessment and the mechanical design for both inner and outer packages (Mechanical Engineer 400 hrs/package, Health Physicist 400 hrs/package, Safety Engineer 160 hrs/package).						400	400	160			
	Complete initial review of preliminary design (Mechanical Engineers 40 hrs/package, Health Physicists 40 hrs/package, Safety Engineers 40 hrs/package, Environmental Engineer 40 hrs/package, Quality Control Engineers 20 hrs/package).				40		40	40	40	40		
	Complete final packaging design, this includes the final safety assessment and the mechanical design for both inner and outer packages (Mechanical Engineer 220 hrs/package, Health Physicist 320 hrs/package, Safety Engineer 160 hrs/package).						320	220	160			
	Complete Licensing documentation (Nuclear Engineer 320 hrs/package).											320
	Complete final review of design (Mechanical Engineers 80 hrs/package, Health Physicists 80 hrs/package, Safety Engineers 80 hrs/package, Environmental Engineer 80 hrs/package, Quality Control Engineers 40 hrs/package, Plant Engineer 80 hrs/package, Managers & Executives 80 hrs/package).			80	40	80	80	80	80	80		
	Complete review of licensing documentation (Mechanical Engineers 40 hrs/package, Health Physicists 40 hrs/package, Safety Engineers 40 hrs/package, Environmental Engineer 40 hrs/package, Quality Control Engineers 20 hrs/package, Nuclear Engineer 40 hrs, Managers & Executives 40 hrs/package).				20	40	40	40	40	40		40
	Comment resolution and incorporation of the design review comments (Health Physicist 40 hrs/package).						40					
	Comment resolution and incorporation of the licensing documentation (Nuclear Engineer 40 hrs/package).											40
	Provide clerical support for documentation development (design and licensing) (Secretary 2 at 80 hrs/package).		160									
	Provide technical editing of the final design and licensing packages (Technical Writers and Editors 2 at 40 hrs/package)										80	
	Total labor hours/ non-labor dollars per Task		160	90	100	120	920	780	480	160	80	400
	Total		160	90	100	120	920	780	480	160	80	400